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Index to Advertisers and Classified Index Following Reading Matter.

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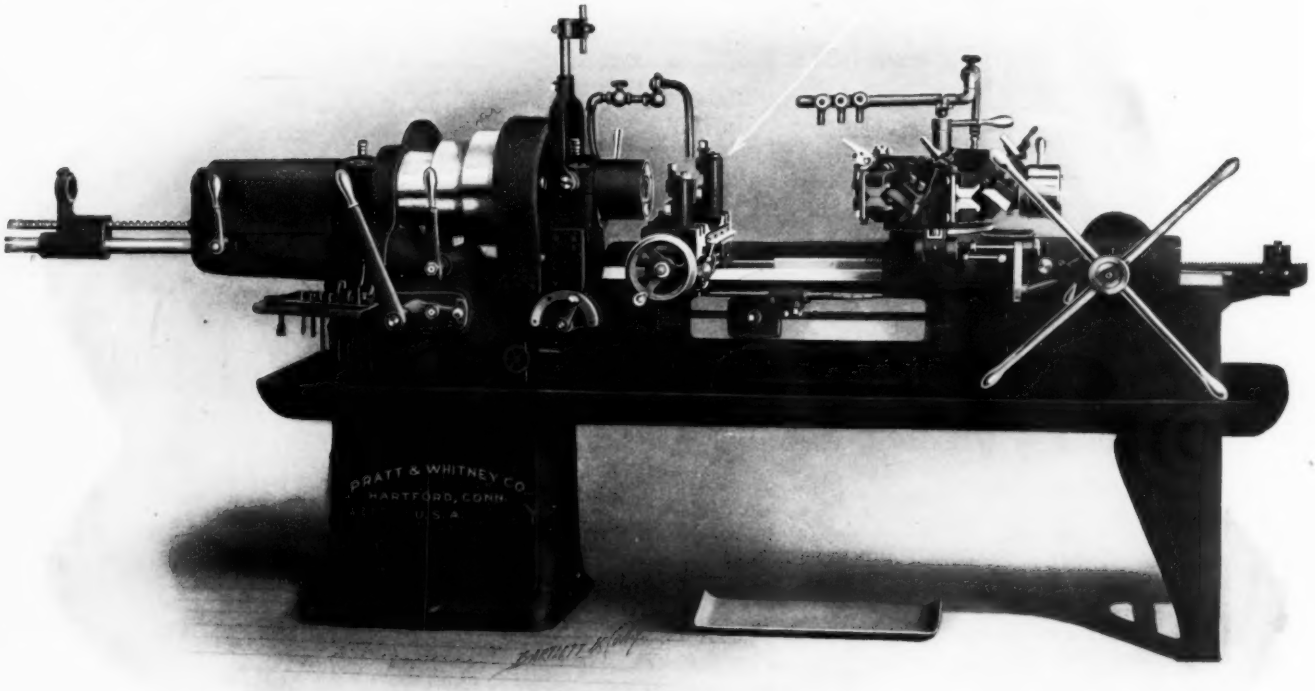

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The United States Arsenal at Rock Island—I.

BY F. A. STANLEY.

Well to the south of the main channel of the Mississippi River, at a point where this ever-deviating stream in its passage between Illinois and Iowa follows temporarily a westerly course, lies Rock Island, the site of one of the most important of our national arsenals. Of irregular contour, and with a length of nearly two and three-quarter miles and maximum breadth of three-quarters of a mile, this island comprises an area of about 1,000 acres. Located between the adjoining cities of Moline and Rock Island, on the Illinois bank, and the Iowan city of Davenport, it is 180 miles west from Chicago, and—following the Mississippi—330 miles north of St. Louis.

EARLY HISTORY OF THE ISLAND.

It is now just a century ago that the island was secured to the government by a treaty with the Sac and Fox Indians; but not until a decade later was it occupied by whites, when during Madison's administration a military post was established at the extreme northwestern point of the island, and, in honor of the then Secretary of War, named Fort Armstrong. Completed in 1817 Fort Armstrong was maintained as a frontier post, with a garrison of two companies of infantry, for about twenty years, or until 1836, when it was vacated by the troops. During this period the event of greatest moment in which the fort and its occupants figured was the Black Hawk war of 1831, in connection with which a number of men destined to become famous as military and political leaders saw service in the vicinity of Rock Island. Among these were Abraham Lincoln, who served as a captain of volunteers thru the campaign; Lieut. Col. (afterward President) Zachary Taylor; Lieut. Jefferson Davis, later Secretary of War under Franklin Pierce, and President of the Confederacy, and General Winfield Scott.

In Gen. D. W. Flagler's exceedingly interesting "History of the Rock Island Arsenal," published in 1877, some of the articles of the 1809 treaty with the Indians are given. By this agreement, which secured to the United States a large tract of land on the Mississippi, the Sac and Fox tribes were to receive "the friendship and protection of the United States, which is now extended to them; goods (to the value of two thousand two hundred and thirty dollars and fifty cents), which are now delivered, . . . and yearly and every year goods suited to the circumstances of the Indians of the value of one thousand dollars. . . ." It seems that Black Hawk, the principal chief of the Sacs, refused to sign this treaty, and during the subsequent war between the United States and Great Britain did not consider its provisions as to friendship, etc., binding. He was still further aggrieved when in 1828 and '29 a considerable portion of the land in question, which in 1816 had been ceded to the Ottowas and other tribes in exchange for territory along Lake Michigan, was repurchased by the government at a much higher figure than that originally paid the Sacs and Foxes for the entire tract, and up to the time of his capture, at the close of the war of 1831, he made life more or less exciting for both soldiers and settlers in the Rock Island region.

SELECTION OF THE ISLAND AS AN ARSENAL SITE.

In 1835 Congress directed that an examination be made of various sites for a Western armory, and during the next two decades numerous reports were made by army officers, suggesting the selection of the island of Rock Island for this purpose and citing its many natural advantages as an arsenal site, among these being its location in the Mississippi rapids, where, owing to a fall of several feet and an immense volume of water, a great water-power was available; its security from enemies in time of war; its convenient location relative to supplies of fuel and ore; the facility with which material might be received and shipped. Not until July 11, 1862, however, did Congress pass the act and make an appropriation for the establishment of Rock Island Arsenal. And as the intention of the authorities at that time was to construct merely a small arsenal for storage and repairs rather than for manufacturing purposes, the appropriation granted at the outset was but $100,000.

INCEPTION OF THE ARSENAL AND PROGRESS OF CONSTRUCTION UNDER VARIOUS COMMANDANTS.

Maj. C. P. Kingsbury was assigned to the command of the island, and in 1863 commenced the construction of the first building, a storehouse, which stands at the western end of the island, and on the map, Fig. 1, is shown just to the west of Rock Island avenue. This building, which is constructed of Le Claire limestone, is 180 feet long by 60 feet wide, five stories high, including basement and attic, and has at the north side a clock tower nearly 120 feet high, the clock having four dials, each of which is 12 feet in diameter, tho from the ground they appear to be not over half that size. The building was completed in 1867, two years after Gen. Thos. J. Rodman became commander of the island. During Major Kingsbury's command the central portion of the island was used as a military prison, where some 12,000 Confederate soldiers were confined, and this made impossible the erection at this time of any further buildings, altho the government in 1863 had decided to reserve the entire island for military purposes and to construct thereon a great manufacturing arsenal. For the greater portion of the time elapsing since the removal of the garrison from Fort Armstrong the island had been in charge of government agents; numerous settlers had located or held claims at various points, and after the Washington authorities directed that the whole island be reserved for arsenal purposes much of the first commanding officer's time and attention was taken up in disposing of the claims of these different individuals.

When General Rodman assumed command in 1865 he proceeded at once to map out the general plan of the arsenal buildings, and the main shops as they stand today are practically as he designed them. The plan as arranged and as eventually carried out, provided for ten great buildings near the center, or highest point, of the island, the land rising here to about twenty feet above the river. The shops are laid out in two rows of five each, precisely as shown on the map, the ground plan of each being as represented in the sketch Fig. 2. The first scheme provided for a connecting shop between the two wings, as indicated by the dotted lines; and in this first plan side and front porticos were not included. Before construction operations were started, however, it was decided to throw out porticos at the points shown, these adding greatly to the appearance of the buildings, and to leave out the connection between the side wings, as this would be a serious obstruction to an otherwise clear and useful courtyard.

Under Rodman two of these shops—B and C*—were begun and nearly completed, and much other important work undertaken. Officers' quarters and other buildings were started, a reservoir was built and considerable work done in connection with the development of the water power. A wing dam was extended from the eastern end of the island to a point several hundred yards up the river and progress made on a water-power dam a few hundred yards southeast of the site of the shops. Upon the death of General Rodman (who was buried on the island) General (then Captain) Flagler took up the command and for fifteen years remained at the arsenal, carrying out the work of construction, and most of the shops were completed during this period. Moreover, the soldiers' barracks, the post buildings, and the Moline highway bridge were erected; the sewage system, the main avenues and streets, and many miles of drives winding about the island were laid out; the trees about the shops were planted, and other undertakings of importance carried out under his command. Following him at the arsenal came in succession several other ordnance officers as Commandants, Gen. A. R. Buffington taking charge in 1892. As the period of construction was practically over at this time, his efforts—like those of the present Commandant, Lieut.-Col. S. E. Blunt, who relieved

*The shops are officially known by the letters given in Fig. 1.

him in 1897—were directed more especially toward the development of manufacturing methods and the production of finished material for the army. This very interesting work, which has been brought to a high degree of perfection, will be taken up later on in this series of articles; for the present let us consider the manufacturing buildings themselves:

THE TEN GREAT SHOPS AND THEIR SURROUNDINGS.

Of U-shape, as shown in Figs. 1 and 2, and arranged in two rows which face each other with the legs of the U, or the wings, extending to the rear, the buildings present a decidedly imposing appearance. The two lines of shops are about 125 yards apart and are known as Armory Row and Arsenal Row, the one to the north, the other to the south of Main avenue—a broad macadam thoroughfare as hard and white as marble, which stretches away from Fort Armstrong avenue to a point well beyond the shops, whence, as a somewhat narrower highway, it continues to the Moline bridge at the eastern end of the island. West of Armory Row is located the office building, and directly across Main avenue and in line with Arsenal Row is a guard- and fire engine-house.

The general appearance of the shops, their massive proportions, and something of the beauty of their immediate surroundings, are revealed by the half-tones Figs. 3 to 6, inclusive, the latter engraving giving a view down a cycle path which the present Commandant has had laid out to the south of Main avenue for the benefit of the hundreds of employees who wheel to and from their work. To the right in this view will be noticed a portion of the "gun yard" which lies on either side of Main avenue and where a great number of obsolete cannon and cannon balls—trophies in many instances of the War of the Rebellion—are artistically arranged. Many wooded sections like that shown, grass plots around the works, and meadows, lawns and drives about the officers' quarters and the island generally, make of it a beautiful park and an ideal site for this manufacturing establishment.

SHOP DIMENSIONS.

The important dimensions of the shop buildings are given in Fig. 2, and, as all are alike in plan, it will be seen that the frontage of each is 210 feet, while the wings are 300 feet deep and 60 feet in width, the courtyard measuring 238 feet in depth and 90 feet in breadth. All but two of the buildings are four stories high, including basement and attic, and the total floor area in each of eight buildings is therefore about 44,000 square feet—a little more than an acre. The central structure in each row is but one story high, with monitor roof, this structure in the case of the south row being designed for a foundry and blacksmith shop, and the corresponding building in the north row for a forge shop and rolling mill. Between the

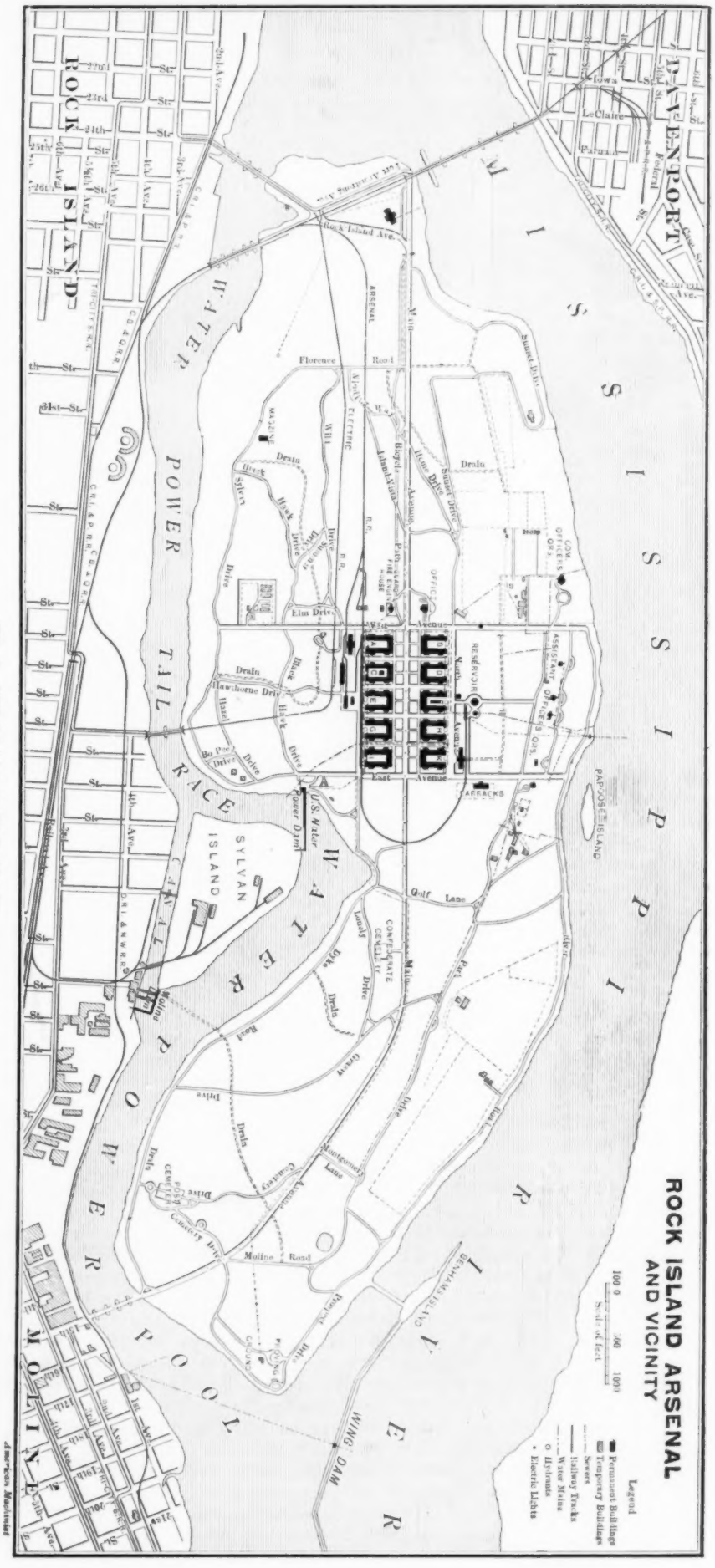


FIG. 1. THE ISLAND OF ROCK ISLAND.

American Machinist

wings of one building in each row is installed a boiler plant for generating steam for heating the shops and for other purposes.

The solid stone walls of the shops are over 3 feet thick for the first story, nearly 3 feet for the second, and 2 feet 4 inches for the third. The lower floors are carried by heavy I-beams supported by the walls and by stone piers, which are spaced about 20 feet apart in the basement. Between the crossbeams, which are placed at intervals of about 5 feet, are fireproof, bricked arches, and above these are wooden joists, on which the floors are laid. The I-beams for the two floors above are supported by iron columns; and wrought-iron frames carry the slate roof.

ERECTION OF THE BUILDINGS.

General Flagler, in his history, gives many interesting facts in connection with the erection of these buildings. Shops B and C, as already noted, were started first (in 1867), and Gen. Rodman, then in command, located temporary shops on the present site of shop A, where construction work could be carried on for the permanent buildings then being erected. Shop E—the foundry and blacksmith shop—was started in '71 and finished soon after the completion of B and C, in '73, and then the temporary structures were torn down, their equipment removed to shops C and E, and work on shop A commenced. Meanwhile two cupolas were put up for the foundry, and the blacksmith shop was partially equipped, so that iron columns, angles and many other parts required in the erection of the buildings could be turned out on the spot; and in fact from this time on these two departments were more or less constantly engaged, either on building material or on supplies for the army. Work was progressing at this time on several other of the main buildings, and all of these, with the exception of K (the end one in Armory Row), were completed by General Flagler. This latter building, as well as two storehouses—one

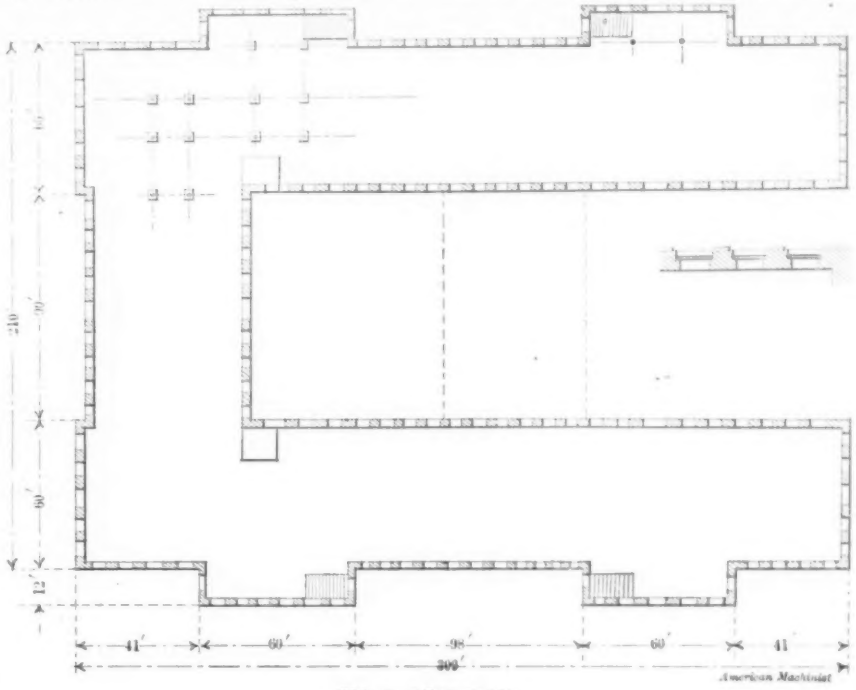


FIG. 2. SHOP PLAN.

FIG. 3. VIEW DOWN MAIN AVENUE, LOOKING EAST.

behind either row of shops—was not finished until the early nineties, when the arsenal railroad, which already communicated with the south row of buildings, was extended to reach the storehouse in the north row.

The work of construction on the shops was not all clear sailing; more or less delay was caused by the contractors who supplied the stone; in certain instances a good deal of trouble was experienced in reaching bed rock for the foundations; and on at least one occasion—in '74—a strike of stone masons delayed progress for a short time. It is interesting to note here that much of the material in the way of I-beams was furnished by Cooper & Hewitt, of New York. The beams, it is stated were wrought iron, and the price paid for 15-inch, delivered at the arsenal, was $6.84 per 100 pounds. Shafting was made on the spot; thus in '82 the Commandant reports having rolled from scrap a lot of 3- and 3½-inch shaft, a rolling mill having been installed some time before in shop F. A little later some 1,200 feet of main-line shafting was finished and put up in machine shop G, and two power elevators were also built and installed in this building.

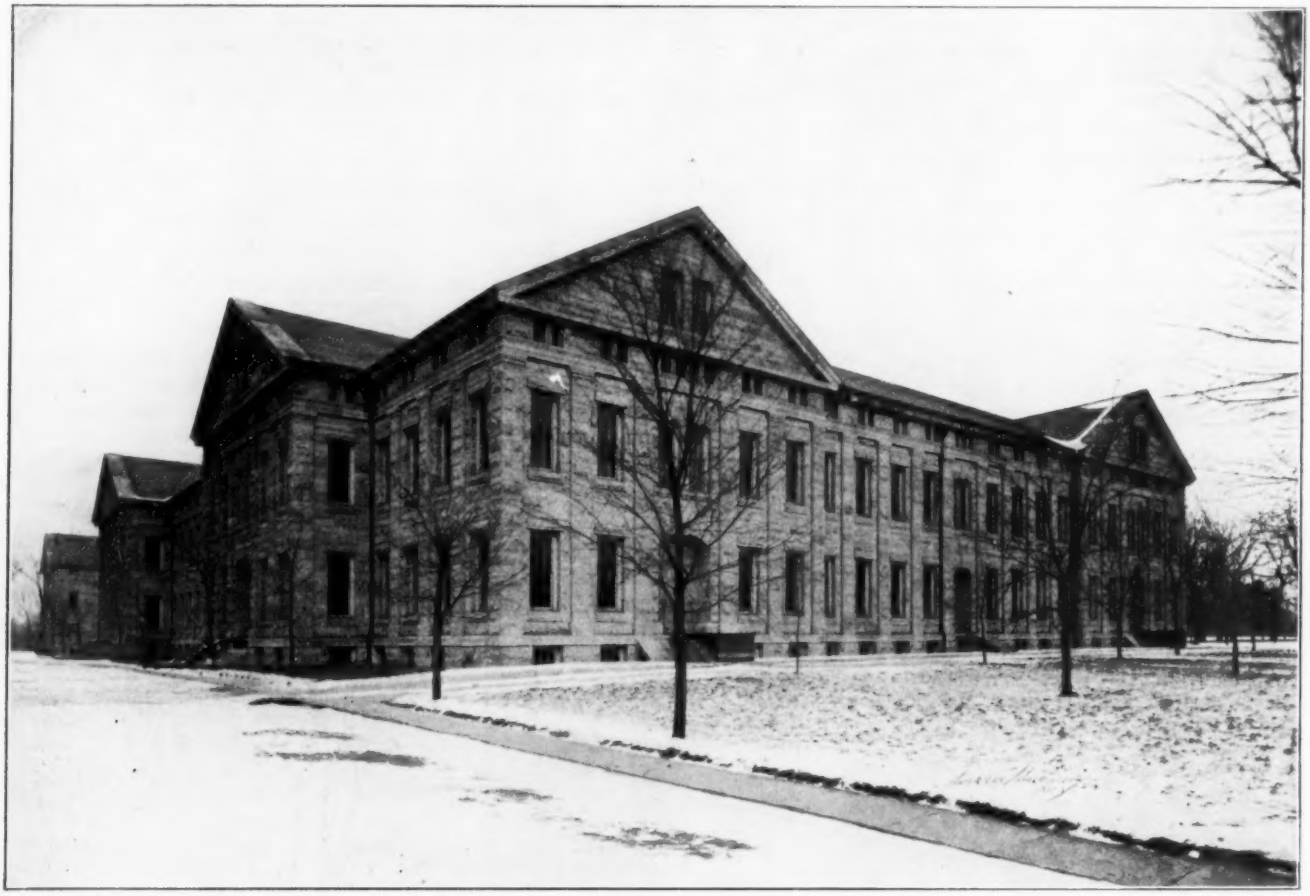


FIG. 4. ONE OF EIGHT SHOPS.

DEVELOPMENT OF THE WATER POWER AND POWER TRANSMISSION.

It seems proper at this point to take up briefly the development of the water power and the installation, under Colonel Blunt, of the interesting and efficient power plant by which the shops are operated and the grounds and buildings lighted. Reference has previously been made to General Rodman's work in connection with the wing dam—which forms one side of the water-power pool—and the government power dam, the location of which will be understood from Fig. 1. This latter dam was thrown across the narrow branch of the Mississippi flowing to the south of the island, and it was at first proposed to utilize the 7-foot fall of the Rock Island rapids in compressing air for use in operating the machinery. Later, General Flagler, then in charge, decided to run a heavy shaft under the south row of buildings as far as shop C, and to operate this by wire rope transmission from a shaft located at the dam and driven by four 65-inch turbines. Five intermediate towers were erected to carry the sheaves, and practically all the work on these, as well as on the water wheels themselves and the shafting, was done at the arsenal. The distance from driving to driven shafts was something like 1,800 feet, and the installation, altho retained for many years, did not prove completely satisfactory, especially when overtaxed thru the addition to the plant of considerable new machinery. Furthermore, the plan included no provision for driving the north row of shops, and when, eventually, it became apparent that these would soon be required for the manufacture of small arms, it was decided to install an electric plant and equip all the shops with motors.

Previous to this—in fact, about 1890—the dam had been reconstructed and openings provided for forty-one wheels, altho only eight were placed at that time. These answered for the comparatively light service required up to the beginning of the Spanish War, but from that time on the great increase of work at the arsenal made it necessary to drive much of the additional machinery by steam power. Preliminary to the electric installation decided upon, the wing dam was extended up the river about two miles to what is known as the Duck Creek chain of rapids, and by this move the head of water was increased to nearly eleven feet. At the same time the tailrace was widened, and also deepened and this made necessary similar operation in the canal leading from the Moline dam, at which point is situated the station which supplies the three cities with power and lighting current.

THE NEW POWER PLANT AND ITS RECENT ADDITION.

In putting in the new power plant at the government dam in 1901, the eight turbines were replaced with fourteen 50-inch Leffel wheels, and two General Electric 500-kilowatt three-phase alternating-current generators with their exciters were installed, a neat building of Milwaukee brick being put up on the dam to house

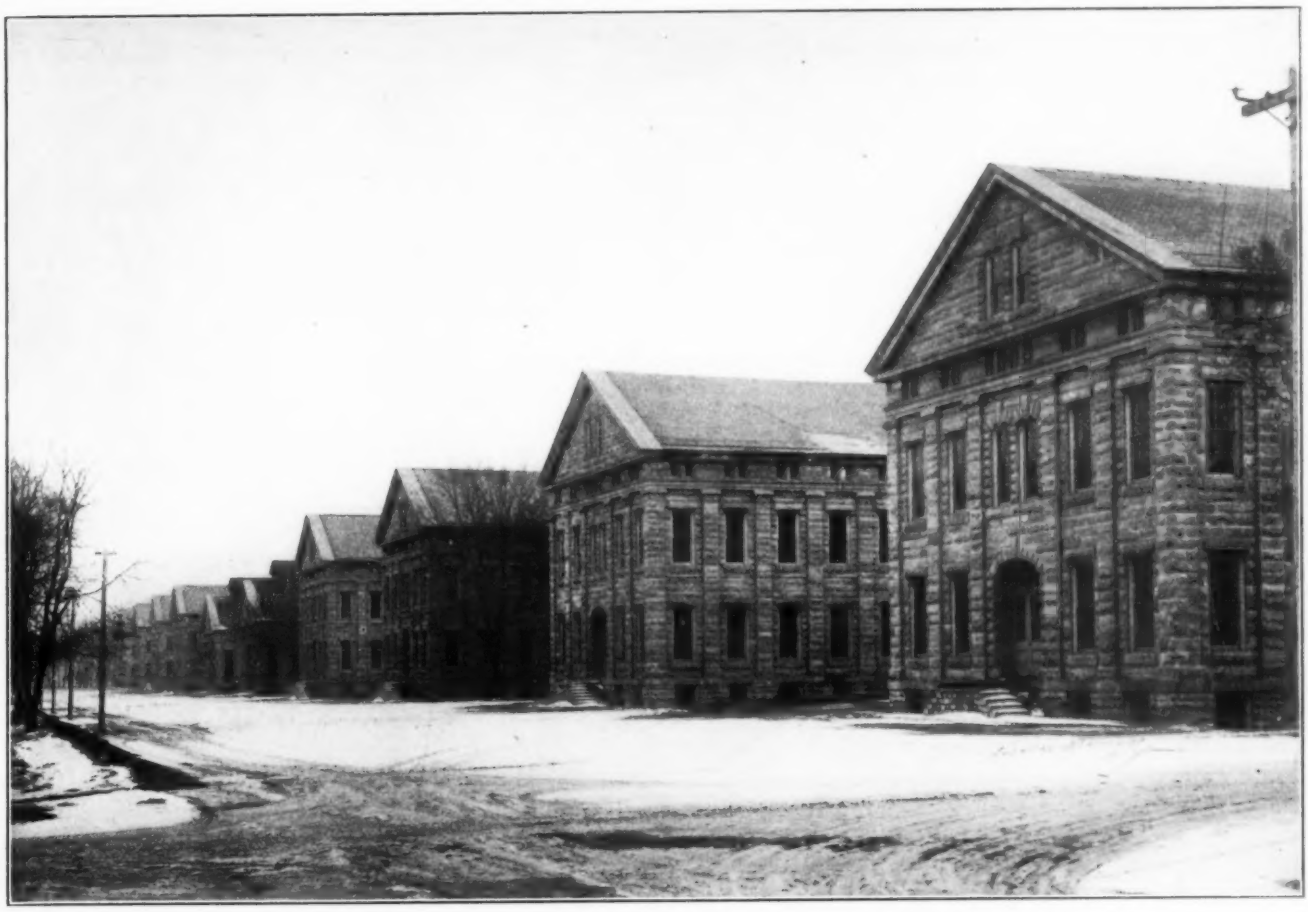


FIG. 5. VIEW DOWN NORTH AVENUE, SHOWING REAR ENDS OF THE FIVE SHOPS IN ARMORY ROW.

FIG. 6. THE CYCLE PATH.

the equipment. To carry the wires to the shops a concrete subway or tunnel was constructed from the dam to the two shops at the eastern end of the plant, cross tunnels were run under each row of buildings and brackets secured to the tunnel walls along which the cables were laid. This tunnel is arranged to be lighted by incandescent lamps along the top of the arch, is about seven feet high and wide enough to allow a comfortable passage from end to end—a distance of 2,200 feet—so that the conductors are easily inspected at any time. As may be imagined, however, very little is necessary in the way of repairs to the line. About a year and a half ago the power plant was enlarged to receive a 650-kilowatt generator of 380 feet and is in three main sections so that any one of the machines may be operated indepcndently if desired, or the three units run in unison; the shaft is equipped with magnetic clutches and ranges in diameter from 7 15-16 inches down to 5 7-16 inches at the exciter ends. The turbines in each group are arranged right and left hand, to obviate end thrust so far as possible, and each section of the shaft is equipped with ball thrust bearings; roller bearings under the gears taking the weight of the vertical shafts. The speed of the main shaft is 200 revolutions per minute and each section is controlled by governors and electric apparatus which automatically operate the groups of gates. Tachometers on the wall show the speed

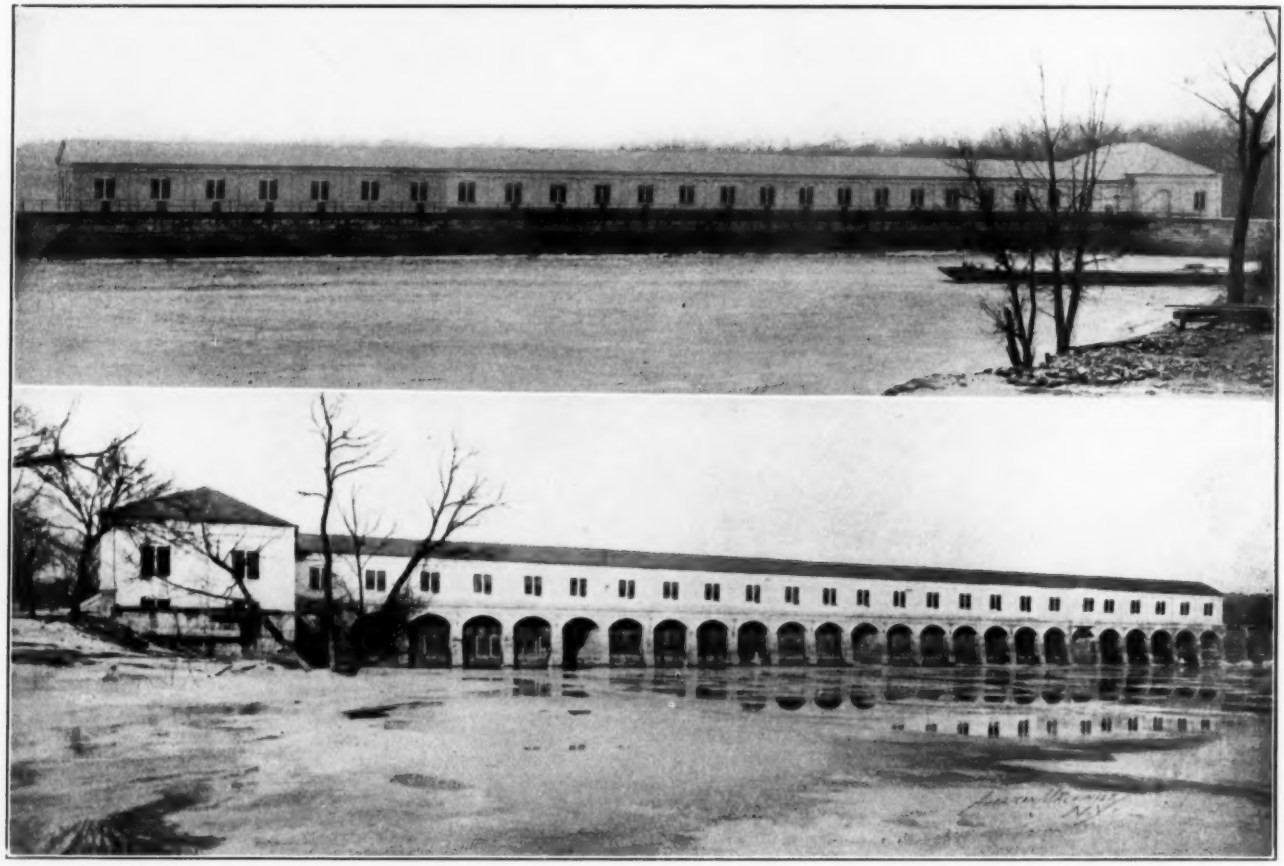


FIG. 7. THE POWER-HOUSE FROM ABOVE AND BELOW THE DAM.

and six wheels were added, bringing the capacity up to 2,500 or 3,000 horse-power. The building was increased considerably in length and Fig. 7 gives an excellent idea of its present appearance, both from above and below the dam. An interior view down the long, narrow building is given in Fig. 8, and, as will be noticed, this photograph was taken with the machinery in motion, the heavy cog wheels actually appearing like friction disks. The arrangement of the switchboards is illustrated in Fig. 9. Like the office building, the power house is warmed by electric heaters some thirty of which are disposed about the building.

The generator shaft has a total length of each section, and hand regulation is possible whenever required. In the basement, near the entrance to the tunnel, are located transformers which step up the lighting main pressure from 600 to 2,100 volts; this pressure being cut down at the necessary points in the circuit to the proper lamp voltage. The motors deriving power from this station number over one hundred; they are mostly of the ceiling type and have an aggregate capacity of 2,300 horse-power.

THE GOVERNMENT BRIDGE.

I wish to mention in this article one other prominent feature in connection with the island of Rock Island—the government bridge shown in Fig. 10. This double-deck structure spans the Mississippi from the island to Davenport, and is about 1,500 feet long with a draw near the island end. It carries overhead the double tracks of the Chicago, Rock Island & Pacific Railway (which crosses the western end of the island) and has below a wagon road and double trolley tracks. The draw is 368 feet in length and is said to be one of the heaviest ever built. The structure was erected by the Phœnix Bridge Company in 1894, replacing (on the same piers) a draw bridge which had been in service for twenty years.

The first iron works to be built in America were erected by the London Company, of London, Eng., in 1619, near Richmond, Virginia. The cost of constructing the furnaces and opening the mines amounted to $200,000, which, for three years produced a good quality of iron. The name of the village which sprung up in the vicinity of the works was Warwick, in remembrance of Warwickshire, the district from which many of the workmen emigrated. Before the mines were successfully operated iron was manufactured from a bog ore gathered from the meadows in the neighborhood of the creek. All went well until one day in March, 1622, the Indians under Opitchapan surprised the village and murdered all the inhabitants with the exception of a boy and girl who hid in the woods.

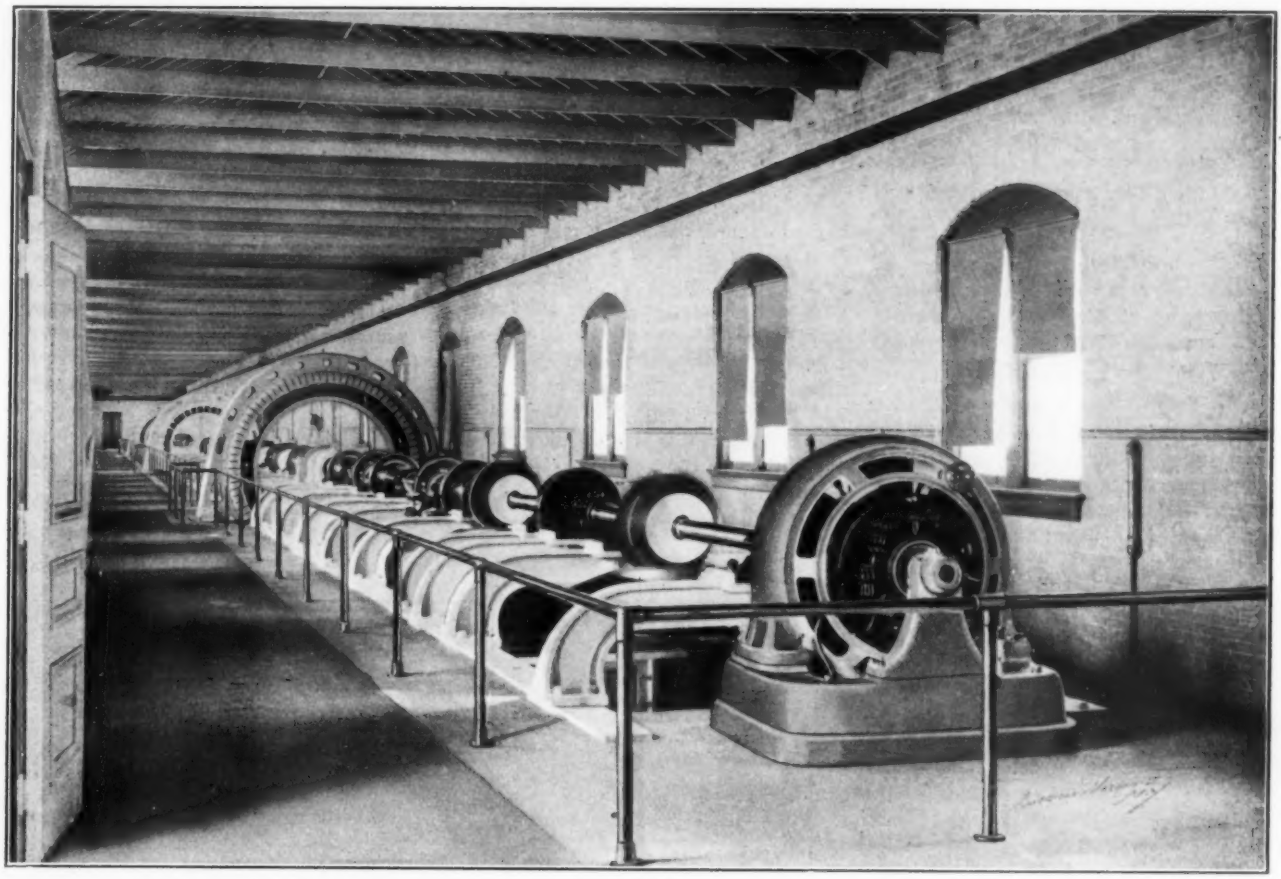


FIG. 8. INTERIOR OF POWER-HOUSE, SHOWING LONG GENERATOR SHAFT.

FIG. 9. INTERIOR OF POWER-HOUSE, SHOWING SWITCHBOARD.

Emery Wheel "Dressers" and Grinding Wheel "Truing."

BY C. H. NORTON.

Claude R. Pitrot (at page 18), while not of course intending to mislead, does so, I think, when he writes just as if the diamond were no longer needed in connection with grinding wheels, and as if a broken piece of carborundum wheel had special virtue as a wheel dressing and truing material over all other abrasive materials, when made up in the form of wheels or sticks with bond.

NO DRESSING OF WHEELS.

There is yet a large amount of misunderstanding about grinding wheels, their construction, selection, and use.

First, when grinding round or cylindrical work, if we obtain really good work in a commercial way by the modern method, we do *not* "*dress*" the wheel. Dressing the wheel is for rough foundry work, snagging and similar cases where ignorance or carelessness about the right use of the wheel forces the purchase of a wheel too hard for the work, in order to prevent expensive wear of wheels. The rugged, muscular force of the operator, combined with the occasional dressing, are relied upon to maintain the cutting qualities.

"Dressing" is a sharpening process made necessary, *always*, because of violation of law. If the laws of selection and use were obeyed, the wheel could never need sharpening, but rather would in some cases need "dulling." When the act of grinding the work will not keep the wheel sharp, law is violated and the work is expensive in consequence.

Modern grinding uses a wheel of such a grade and in such way that instead of getting dull by work it is being dressed by the act of grinding; thus it is always in danger of becoming rough and "untrue" with heavy and over work. We then true it perfectly true and smooth, with a face exactly parallel with the axis of the work, and just in proportion to the smoothness and correctness of its face do we obtain smooth and correct cylindrical work.

DRESSER VS. WHEEL.

Neither carborundum, alundum or corundum will produce a perfectly straight face wheel with a smooth surface, but rather they will *all* "dress" out the bond between the cutting particles of the grinding wheel, allowing the particles to fall away and thus *rudely* shape or turn off the wheel; that is, they will do so *if* the piece of wheel is held together with a bond sufficiently hard to resist the bond of the wheel it is to dress or turn off; but if not, the wheel will grind it right away whether it is made of carborundum, corundum, alundum or emery.

It is a common thing to use pieces of broken wheels to turn off wheels where they are manufactured, but never to produce perfect work. This method will remove material from the wheel whether we use carborundum, alundum, corundum or even emery if there is the right selection of grade between the wheel to be turned and the piece of wheel with which it is to be trued. If not, it cannot be done. There are grinding wheels in use everywhere that no grade of corundum, carborundum or emery stick can make the least impression upon—even to dress them.

THE DIAMOND IS NECESSARY.

The diamond is the only substance now known that will make a perfect face. We would not expect to make any other work perfectly true, smooth and straight by holding the truing tool in the hand and moving it sideways to obtain such accuracy; why should we expect to obtain a *true* and *parallel* face on a grinding wheel by holding our tool that way? Yet many do. If Mr. Pitrot should try his carborundum stick, held rigidly in a tool-post and feed it past the wheel face slowly with power feed and then try the wheel against some nice, straight piece of work, he will find an uneven face on the wheel. The wheel would also cut a coarser surface than when trued with a diamond held in the tool-post. This error of face becomes very great when using carborundum on a

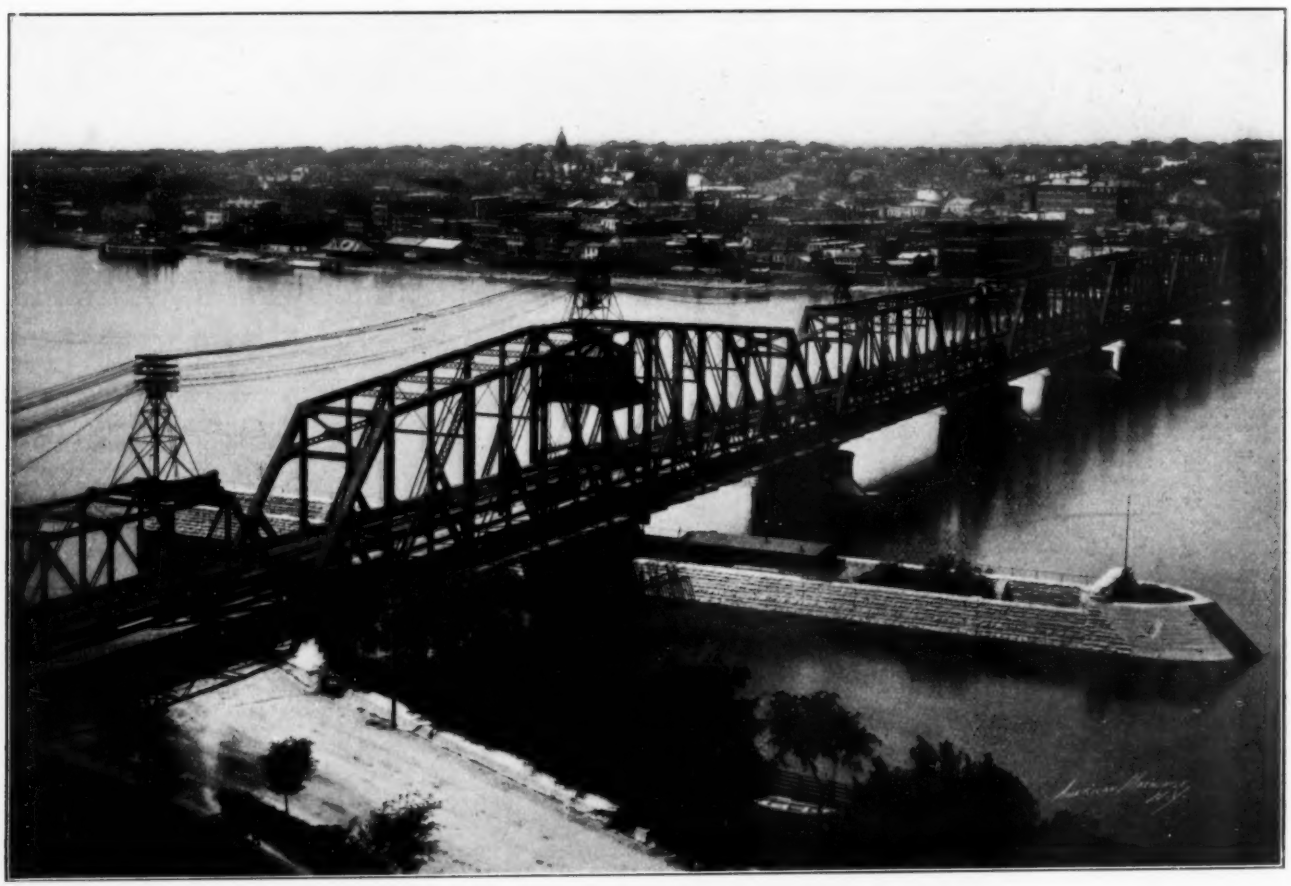


FIG. 10. THE GOVERNMENT BRIDGE FROM ROCK ISLAND TO DAVENPORT.

wheel 4 inches wide, but the diamond gives such perfection that no error can be detected when the wheel cuts the work; an error of .0001 inch is easily detected when taking a finish cut.

He speaks of "emery wheels." Is it not time we considered the fact that many grinding wheels are not made of emery? In fact, the most of them are not.

There are four cutting materials now used—emery, alundum, carborundum and corundum—but all are *grinding wheels*.

There are substitutes for the diamond advertised by patent medicine names, and to read these advertisements one would think that the people making them really believed that they would do the work of a diamond, but if they should see one melt away without making any impression on the wheel as I have done they would change their views. One says, however, that it does only "75 per cent. of the work of the black diamond" What is to be done when the wheel lacks "25 per cent." of true, smooth and parallel? Cylindrical work ground by such a wheel will lack "25 per cent." of perfection. If cylindrical grinding means anything it means perfection. Correct and economical cylindrical grinding cannot be done without the aid of the diamond.

The diamond should be flooded with water while using. The absence of a flood of water allows the diamond to become ground off and wasted.

The diamond should be held rigid in a tool-post. It should be passed *slowly* across the wheel face to dull the face, as well as to make it perfectly straight and the wheel *perfectly true*.

Cylindrical work can never be more perfect than the cylinder that grinds it.

Shafting and Pipe Brackets for Steel Buildings.

The cuts illustrate a new system of attaching or supporting shafting and pipes in buildings with steel columns of the standard sections. It often, if not generally, occurs that lines of piping, for compressed air, water, oil, etc., are required to run practically parallel with the line shafting, and the brackets here shown not only provide for this contingency but also utilize the piping for carrying intermediate brackets which may be required between the columns of the building for steadying the shafting or for carrying countershafts, etc. Fig. 1 shows the details of a typical bracket of this system. These brackets do not require any drilling, and consequent weakening, of the columns, being attached by hook bolts gripping the edges of the columns, as shown. The wrought pipe used evidently serves to stiffen and bind together the otherwise unsteadied members. There is little machine work required upon the brackets and they have considerable adaptability to varying conditions. Fig. 2 shows a typical arrangement for driving a boring mill, the line shaft being above and the countershaft below, while the pipes may one of them carry oil and the other compressed air or water. The countershaft in many cases would be attached to other columns, with the belts from the line shaft running horizontal. The boring mill as here shown is given two different belt speeds with backing belts for each. The difference of speeds indicated in this case is presumably equal to one-half the difference of speeds between adjacent steps of the cone pulleys, thus doubling the entire range of machine speeds. The shipper levers are fastened by clamping suitable pieces to the pipes. It is of course unnecessary to call attention to the fact that this arrangement is a distinct contribution to the fireproofing of our shops. It has been designed and, as photographs show us, applied by J. H. B. Bryan, Snow Steam Pump Works, Buffalo, N. Y.

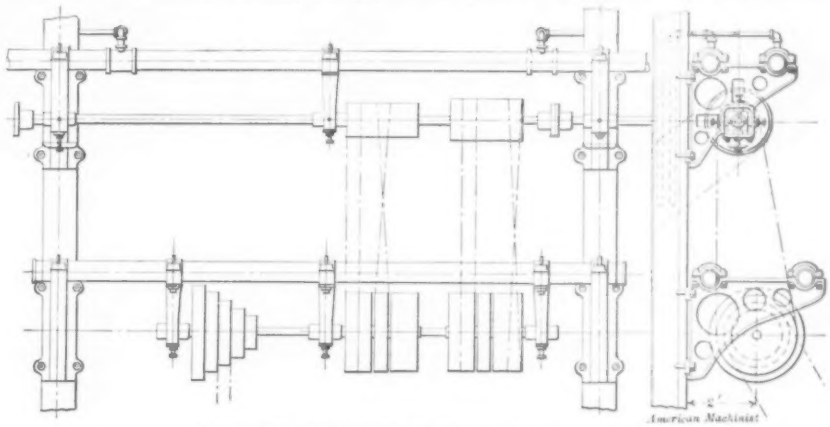


FIG. 2. ARRANGEMENT FOR DRIVING BORING MILL.

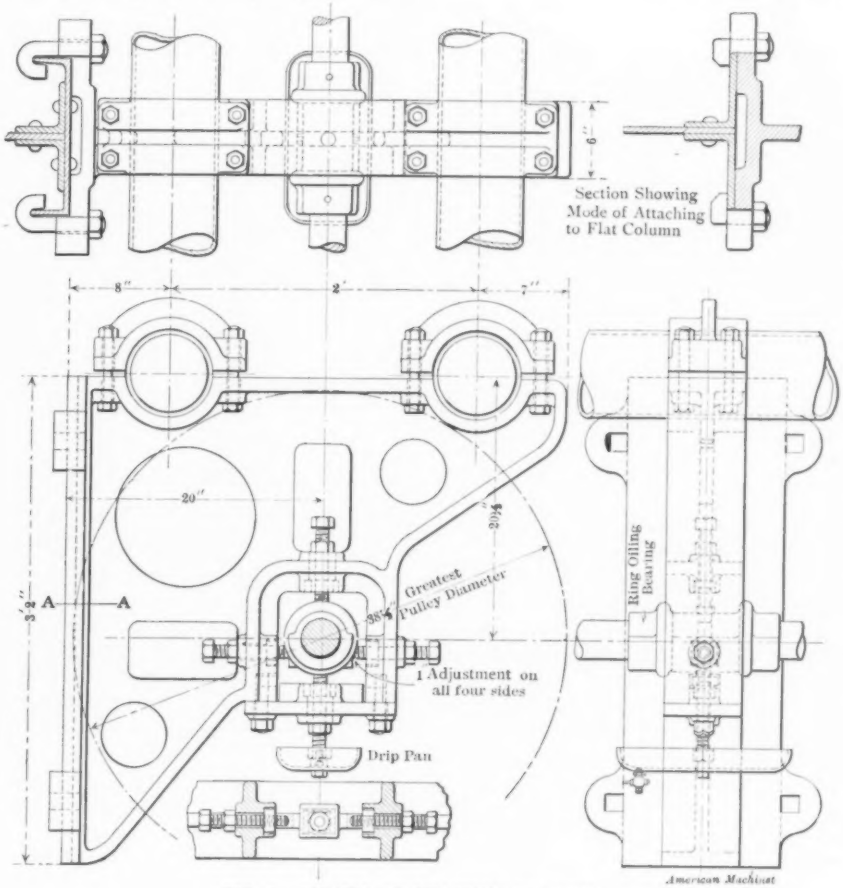


FIG. 1. DETAILS OF SHAFTING BRACKET.

T. H. Marburg, representative in the United States of the machinery house of Alfred H. Schutte, Cologne, Germany, has been selecting examples of the various kinds of American machine tools to be exhibited at the coming international exposition at Liege, Belgium. It is said that this house has reserved for its American connections 45 per cent. of the entire space allotted to United States exhibitors. One of the largest exhibits of machine tools ever made is assured at this exposition and to a great extent they will be shown in operation. The exposition opens April 30, 1905.

Studies in Inventive Problems—III.

Proposed by Leicester Allen and Solved by Various Readers.

Problem 1 has called forth a larger variety of solutions than was expected.

J. L. Gard, of Denver, Colo., has sent a model of a device which fails in two particulars. With a square sliding block it will not make the turn at the corner, and hence he has truncated one corner of the block. Secondly, it does not make the vertical branch of the path one-half the length of the horizontal path, which is a rigid condition. Nevertheless, this imperfect solution is noteworthy, and is so near to what I regard as the best possible solution that I shall again refer to it when I present my own solution.

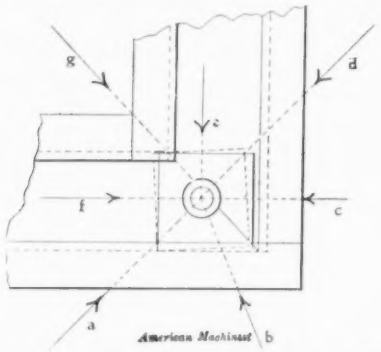


FIG. 1. STUDY OF FORCES WHICH MAY TILT THE BLOCK.

F. G., Stockbridge, Mass., sends a neat sketch, which, analyzed, is found not to make the vertical part of the path half as long as the horizontal part, and which in operation will bind the sliding block in passing the corner.

F. G. Van Sant, of Paragould, Ark., sends as a solution a drawing and description of mechanism intended to move the block to the corner of the path, where it disengages and another mechanism is supposed to simultaneously engage the block and move it to the terminal of the shorter branch and back again to the corner, releasing the block at that point, while the other mechanism re-engages the block and moves it to the terminal of the longer branch and back to the corner. This would satisfy the terms of the problem if the releasing and engaging could be made instantaneous as well as simultaneous; but I think Mr. Van Sant will see that the mechanism shown in his drawing will not operate in that way, and so much slack, or lost motion, would need to be allowed that the block would briefly stop on the angle, which is contrary to the requirements.

The tendency of the block to tilt and bind in the ways when turning the angle does not appear to have been perceived by a number who have sent in what otherwise would be considered good solutions. This tendency is illustrated in the diagram, Fig. 1, which shows the block as having been moved toward the angle over very nearly the whole of the longer branch of the path. A force acting in the direction indicated by the arrow at *f* will move the block squarely the full length of the horizontal branch of the path, so that the center of the block will then coincide with the apex of the angle of the two paths. Similarly, a force acting in the direction indicated by the arrow at *e* will move the block squarely back over the shorter branch of the path. A force applied as at *a* or *b* would tend to tilt the block, in advancing over the longer branch of the path, into the position indicated by the dotted outline. If both the latter forces were applied simultaneously the defect would be aggravated. Let the force indicated at *c* be resistance to the movement of the block; then if *a* alone acts to move it the tendency to tilt will be the component of *a* and *c*, and, supposing the forces to be equal, the component will have the direction *b*. Analogously, a force acting in the direction of the arrow at *d*, just before the block, on its return over the shorter branch, reaches the point of coincidence with the angular point of the path, would tend to tilt the block in the opposite direction from that indicated by the dotted outline. The forces *e*, *f* and *g*, acting either alone or together, will hold the block square at the turning point, obviating the tendency to tilt. No device will successfully perform the movement called for by the problem, unless a moving force be applied in one or other of the directions *f*, *g*, *e* and *c*, singly, or a combination of forces whose components act approximately in one or other of those directions, or a special device may be contrived which will hold the block square while describing the angle in the path.

The liability of the block to tilt excludes the drawings and descriptions of a number of contributors. This tendency of the block to tilt has been perceived by others or avoided without apparently perceiving that it must be avoided. In some cases the provision for preventing the tilting is plainly the result of a clear perception. This is the case with a solution offered by Mr. F. L. Robeson, a student at Virginia Polytechnic Institute, whose drawing and the text accompanying it display not only skill at the drawing-board, but great facility in mechanical description.

SOLUTION NO. 4, FIG. 2, BY F. L. ROBESON, VIRGINIA POLYTECHNIC INSTITUTE, BLACKSBURG.

This may be considered a solution in which Prof. W. H. Raoche co-operated, for Mr. Robeson writes as follows:

"The solution was suggested to me by Prof. W. H. Raoche, leaving me to work out the details. The essential parts of the design are a four-bar linkage consisting of a crank *C*, a connecting rod *R* and rocker arm R_1, with the base of the machine as the fixed link; and an engine linkage consisting of a crosshead *H* and guide *G*, connecting rod R_2 and rocker arm R_1. Crank *C*, keyed to its shaft and rotating uniformly, drives rocker arm R_1 and with it crosshead *H* to the right. When the center of the crosshead reaches *P* the stop *L* is withdrawn by cam *K*, leaving the guide clear. As the center of the slide, or crosshead, reaches *P'* the stop *L* is released by the cam, and its spring causes it to bear on the crosshead and to slip across the guide automatically, fitting into an inclined slot cut into the back of the crosshead as the crosshead passes into its corner position. The slot was deemed necessary in order to keep the stop from hanging on the rear edge of the crosshead and also to give the stop time to spring into position behind the crosshead at the instant when the crosshead passes the corner. In this corner position the stop L_1, which is exactly like stop *L* and is driven by the same cam, has been completely withdrawn by cam *K*. On the return swing of R_1 the crosshead *H* is forced by stop *L* to follow the ver-

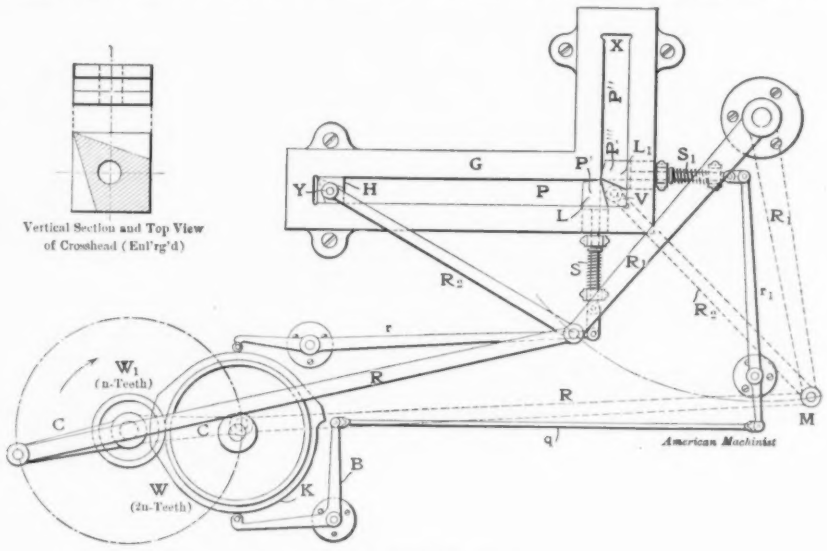


FIG. 2. SOLUTION NO. 4.

tical guide. As soon as H passes L_1 the latter gradually returns to its position of rest across the guide, in which position both stops remain, when not in use, in order to reduce the friction of the cam and the strain on the springs. At the end of the first revolution of the crank H has reached its highest position X, and returns to its initial position Y on the next revolution of the crank, all of the above operations being then reversed.

"Cam K is rigidly fastened to a gear W of $2n$ teeth, W being driven by another gear W_1 fixed on the crankshaft and having n teeth. If it were required to run the crank C in the opposite direction, all that would be necessary would be to take the cam off its shaft, turn it over and replace. One great advantage of this mechanism is its great adaptability to different locations of crank, rocker arm, etc., the positions shown being taken for convenience in drawing. Also, by proper selection of crank lengths and rod lengths, the crosshead may be made to traverse its horizontal and vertical path in times having any desired ratio. Rod R_1 could be dispensed with and a straight guide used in its stead if conditions required. Point N is found at the intersection of arcs struck from the center of the crosshead in its extreme positions, X and Y, with a radius equal to the length of R_2.

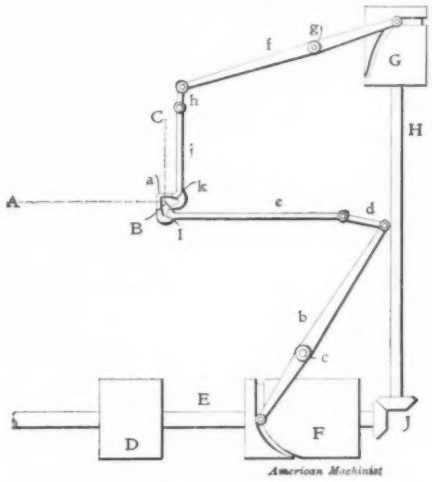


FIG. 3. SOLUTION NO. 5.

"Point M should be taken on the bisection of the right angle of the guide where it is cut by an arc described from the center of the crosshead in its corner position, with a radius equal to R_2. At first glance it would appear that rods R_1 and R_2 are unnecessary and that crosshead H could be driven directly by R. This is theoretically correct; but it requires that the crank circle shall be tangent to each of three circles having radii equal to R and described from the two end positions X and Y and the corner position V of the center of the crosshead, respectively. For this arrangement, however, there would be only one diameter and one position of crank circle for each length of R, which would be inconvenient in many cases, and the travel vertically and horizontally could not be adjusted as to time."

SOLUTION NO. 5, FIG. 3, J. MELANCON, LITTLE ROCK, ARK.

The sliding block has, instead of a central pin, two lugs k and l fastened to the top of the slide. When the geometrical center of the slide coincides with the angle of the path these lugs alternately engage and disengage the forked ends of links, which respectively move the slide to and fro over each branch of the path without pause at the angle, as required. The moving force is thus applied to the block laterally instead of centrally. This is not quite so good construction as a central application; but, with fine workmanship, I think the movement will operate all right. Mr. Melancon describes the movement as follows:

"The dotted line $A\,B\,C$ is the line of motion of the center of the sliding block a, and the distance from A to B is just twice as great as from B to C. D is the driven pulley, keyed on shaft E, which may rotate in either direction. F is a cylindrical cam, keyed to the shaft E, which imparts the horizontal motion to a thru the lever b (which oscillates about fulcrum c), link d and rod e. G is a similar grooved cylinder keyed to the vertical shaft H, which is driven from the shaft E by miter gears J. The grooved cylinder G imparts the vertical motion to the crosshead a thru lever f (which oscillates about fulcrum g), link h and rod j. Now, the groove in cylinder F is so cut that the lever remains stationary during one-third of a rotation of F and oscillates during two-thirds of the rotation, and the groove in the cylinder G is so cut that lever f remains stationary during two-thirds of each rotation of the cylinders and oscillates during the remaining one-third. It will readily be perceived that if the levers b and f are so proportioned as to impart the necessary amount of motion to crosshead a, and if the cylinders F and G are keyed to their respective shafts in such a position relatively to each other that lever f begins its motion at the instant that lever b comes to rest, and *vice versa*, the result will be a continuous motion imparted to crosshead a along the lines indicated, without lost motion at the ends of the stroke, and without cessation of motion while turning the angle. Of course, the rods e and j must be guided parallel to lines $A\,B$ and $B\,C$.

"This device could be rendered more compact by placing the cylinder G down near the miter gears and pushing up on the rod j, instead of pulling, as in the diagram; but the form shown in the diagram was considered preferable for purposes of illustration, as the lines do not cross."

SOLUTION NO. 6, FIG. 4, R. T. STROHM, SCRANTON, PA.

Mr. Strohm sends also another attempt at a solution, but as the sketch is obscure, and the text of the description does not clear up the obscurity, it will have to be turned down. In his solution, herewith given, he evidently perceived the tendency of the block to tilt just before turning the angle of the path, and has very effectively contrived to obviate any difficulty of this sort. His description follows:

"The sketch illustrates a method of obtaining a motion of a block in a path having two branches at right angles to each other. The path of the block is $a\,b\,c$, the block having its center at b. From b lay off the rigid rod $b\,e\,h$, of some convenient length and from e and h construct paths of motion $d\,e\,f$ and $g\,h\,k$ similar in every respect to $a\,b\,c$, with slots and guides for the blocks whose centers are at e and h, respectively. Now, from d lay off $d\,l$ equal to about $2\frac{1}{2}$ times $d\,e$, so that the angle $e\,d\,l$ is not less than 120 degrees. The length of $d\,l$ is taken as the length of the connecting rod by which the mechanism is driven. As d is the end of the horizontal stroke, the point l must be the point at which the crank pin is farthest from the path of motion. Taking

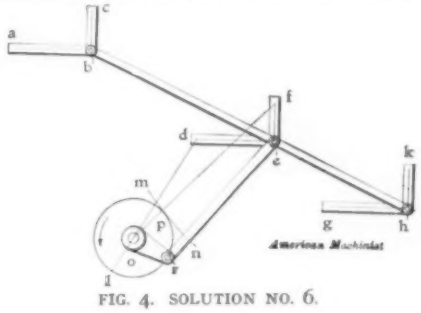


FIG. 4. SOLUTION NO. 6.

$d\,l$ as a radius and f as a center, strike the arc $m\,n$. As f is the highest point of the vertical travel, the crank pin must lie somewhere on the arc $m\,n$ when it is nearest to f. Also the center of the crank-pin circle must lie on $d\,l$, if l is to be the point in the crank-pin travel farthest distant from d. Hence the crank-pin circle is determined by finding a circle, with its center on the line $d\,l$, whose circumference passes thru the point l and is tangent to the arc $m\,n$. This circle is $p\,r\,l$, and the crank is at r when the block e is at the angle of its path. As the rod $b\,e\,h$ is rigid, and is constrained to move always parallel to its position in the sketch, it is evident that the same motion that is transmitted to the block e will likewise be given to the blocks b and h, which is the end desired. The slot $d\,e\,f$ and the block at e might probably be omitted, and the connecting rod $r\,e$ being attached directly to the rod $b\,e\,h$. In such a case the distance $e\,h$ should be greater than $e\,d$."

In method of thought and manner of presentation, Mr. Strohm's solution is one of the best received. It completely solves the problem, meeting fully and convincingly all the specified requirements. But the ground for the statement in the last para-

graph of his description that, in case the slot *d e f* and block *e* were omitted and the rod *r e* directly connected to the rod *b e h*, the distance from the point of connection *e* to the block *h* should be greater than *e b*, is not apparent. A reason for this statement should have been supplied.

SOLUTION NO. 7, FIG. 5, J. H. DICKSON, POLK, PA.

This introduces an element of construction not contained in the previous solutions. The moving force being applied always in the line of motion described by the center of the sliding block, the tendency of the latter to tilt does not need to be considered. The descriptive text following is Mr. Dickson's:

"In explanation of essential features, 1 is an end view of the slide, 2 is a side view of the vertical follower, which is also shown in working position in the ways; 3 and 5 are respectively an elevation and plan of a horizontal follower; 9 is a section of the ways. The theory is that the horizontal follower carries the slide to the right-hand end of the stroke just as the vertical follower is leaving, the vertical follower carrying the slide with it by means of a fixed hook. This hook is adapted to pass between two similar hooks on the horizontal follower and extends part way around the pin of the slide, as shown. For the horizontal follower to receive the slide again on the return stroke its hooks must reach point 8 slightly in advance of the down-coming hook, now carrying the slide. The followers reach the extremity of the 'in-stroke' alternately. The geared mechanism is designed to advance and retard the relative position of wrist 15, with each alternate revolution, which causes the variation of time of the followers reaching the inner end of stroke. The eccentric 12 rocks the arm 16. The gear 10 is keyed to a short shaft which takes a bearing thru the disk or wheel 17, and at the opposite end is keyed to the eccentric 12. 11 is a gear which is fixed to the journal box 14 and is one-half the pitch diameter of 10, thus the eccentric 12 revolves 1½ times for each rotation of disk 17. An eccentric 13 operates the vertical follower thru arms, as shown."

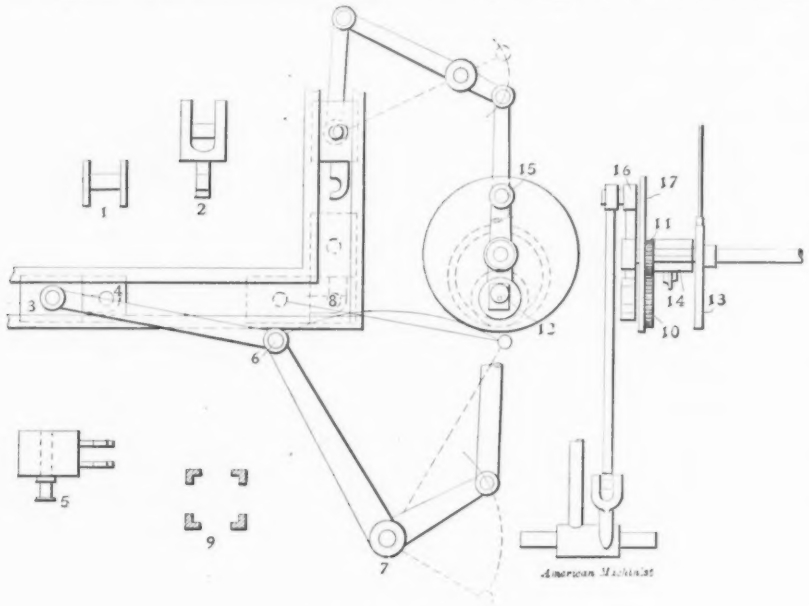


FIG. 5. SOLUTION NO. 7.

SOLUTION NO. 8, FIG. 6, CHARLES W. JAMES, PHILADELPHIA, PA.

The wheel *B* turns continuously in one direction. The pin *E* on its face engages a slotted yoke *C*. The slot in the yoke is so shaped that the vertical motion of the pin *E*, due to its revolution, gives two stops to the yoke *C* and the bar *F*, one at each end of the stroke. The bar *F* is connected to the block *N* thru the bell-crank lever *K*, sliding block *L* and connecting rod *M*. When the bar *F* stops at the end of its stroke *N* also stops at one or the other terminal of its path, as the distance covered by the center of *N* over the horizontal and vertical branches of the path is equal to the diameter of the circle described by the center of the pin *E*. *P* and *R* respectively represent the horizontal and vertical guideways for the block *N*, and *O* represents a guideway for the slide *L*. These guideways are supposed to be of the familiar dovetail variety. The block *N* is kept from canting as it leaves the horizontal guideway by lugs projecting from *L* up along the vertical sides of *N* at the base of the latter. *N* will move horizontally and vertically at about the same speed, as the arms of the bell-crank lever are of the same length, but either movement will be substantially uniform. But, as the arm *K* of the bell-crank lever moves over the arc shown, the bar *F* will not move parallel with itself but will take different positions, as shown by the dotted outlines *K I* and *K' I*, *I* being a pivot on which the bearing *H* of the bar *F* oscillates. The yoke also does not move parallel to itself, but its oscillation, which is small, will not interfere with the action of the block *N*, which will make the movement required. The curved faces in the middle of the yoke bring all the parts to a gentle stop when *N* reaches either terminal of its path. The bar *F* moves freely in its guideway *J*, enough play being allowed above and below the bar to give the bar the necessary freedom. *W* shows the position of the parts when the slide *N* is at the angle of the path.

This solution, while it will perform the required movement, has one grave mechanical defect. Were the block *N* required to overcome any material resistance, as when carrying a cutting tool or working a bending device, the toggle action would cause excessive friction, and I am not sure that its clamping action in the ways would not be sufficient to altogether prevent moven ent.

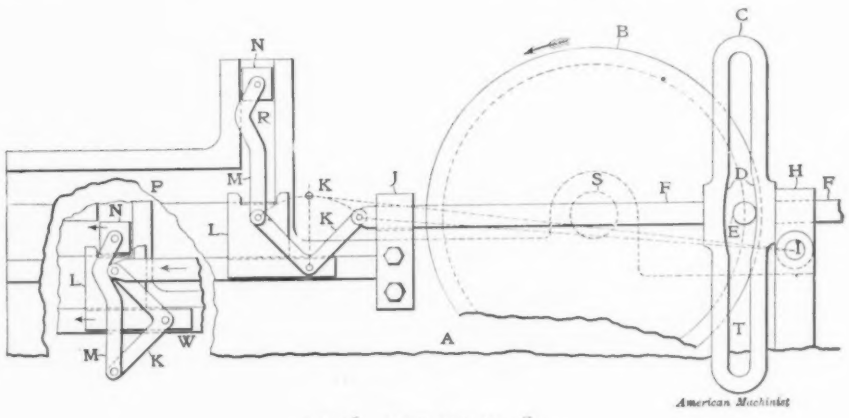


FIG. 6. SOLUTION NO. 8.

SOLUTION NO. 9, FIG. 7, H. B. MC CABE, CHICAGO, ILL.

This is a simple and good movement. Mr. McCabe supplies the description:

"Referring to the sketch, *e* is the square block to be given the specified motion; *a* is its guide, which is shown as a slot in the frame with a right-angle turn. The problem is to cause the block *e* to follow this slot, turn the sharp corner at *a* and travel vertically one-half the distance it does horizontally. I accomplish this by providing in the same frame a long horizontal guide, or way, *b*, preferably dove-

tailed to receive a sliding block *c* fitting freely therein, which may be given a reciprocating motion thru the connecting rod and crank wheel shown. *c* carries another sliding piece *d*, which has the form of a long square bar, the upper end being fastened to the block *e*. This bar slides freely in a long groove cut in *c* at an angle of 45 degrees, or more, with the vertical, being retained therein by the small straps shown. I think it is clear that, while moving in the direction shown, when the block *e* comes to *a* it will, as *c* further advances, begin to ascend in slot *a*. The angle of the slide *d* may be either way from the vertical, and if 45 degrees the travel of *c* must equal the total travel of block *e*. *d* may be screwed rigidly to *e* and prevent its tendency to turn while passing the sharp corner at *a*.

PROBLEM II.

There are still a number of solutions of Problem I to be presented, but I now give out Problem II, to allow ample time for its study:

From any point in a horizontal line of indefinite length, as a center, describe a semicircle. On the semicircle so drawn, set off, from each end of its horizontal diameter, an angle of 60 degrees. Draw from each of these 60-degree points a line

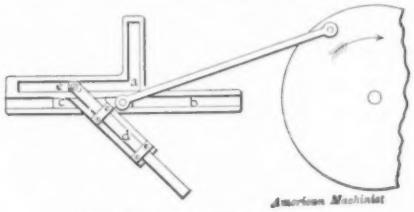


FIG. 7. SOLUTION NO. 9.

to the center of the semicircle. These two last drawn lines are to be taken as equal branches of a path for the geometrical center of a sliding block. That is to say, it will be a V-shaped path of two equal branches, which branches form an angle of 60 degrees. The sliding block, having its geometrical center coincident with the acute angle of the path, is to be made to move first up and down one of the equal branches of this path, then up and down the other branch, alternating the described motion between the two branches, and so on continuously. Mechanism for this is to be supplied deriving its motion from a wheel or crank revolving uniformly in one direction. I do not see any way of avoiding dead points at the angle and at the terminals of the branches, and hence these dead points will be admitted in the solution; but they must not be dead points longer than a single instant or continue longer than the dead points in the revolution of a steam engine. The following devices, singly or in combination, will be excluded, to wit: Sprocket wheels and chain; spur gears, crown wheels or bevel gearing, and all flexible connectors except such as may be needed to turn the driving wheel.

The sliding block which is to traverse the V-shaped path may be guided by ways parallel with the path. The geometrical center of the block must make the angle of its path sharply acute; no rounding off or cutting from this angle can be permitted.

The Application of Motors to Machine Tools.*

BY J. M. BARR.

The conditions under which machine tools operate are so varied that it is impossible to make any general statement covering all of the possible operating conditions. But some of the governing conditions are always important, as, for instance, the character of the work machined, the kind of material cut, the shape of the cutting tool, the quality of the tool steel, the method of treating the tool steel, the stiffness of the machine tool proper, the strength of the gears, etc. All of these should be taken into account in intelligently fitting a motor to any particular machine tool.

Broadly speaking, machine tools may be divided into two classes—first, those with a direct rotary motion, either of work or cutter; and, second, those with a reciprocating motion, either of work or cutter. Under the first classification come lathes, boring mills, milling machines, drill presses, etc. The second class includes planers, shapers, slotters and machines of a similar charcter.

The folowing formulas are based on standard American practise and will be found useful, particularly for estimating work. Under unusual conditions of operation, the horse-power given by the formulas may be greatly exceeded, but if the machine tool is to be run under abnormal conditions, it will be necessary to analyze the power requirements at further length rather than to rely upon empirical formulas.

It is to be noted here that whatever the class of machine tool, the variable-speed motor generally offers decided advantages in the way of rapid and economical production. With the old method of speed variation, by means of cone pulleys or nests of gears, only coarse increments in speed are obtainable. This invariably means that tools cannot be worked up to their limit of productive capacity. With the new high-speed steels requiring a greater pulling power in the belts and an increased strength in the gears, reasonably fine increments in speed, by mechanical methods alone, are almost impossible, owing either to the increased length of the cone pulley or the necessarily abnormal size of the change gears.

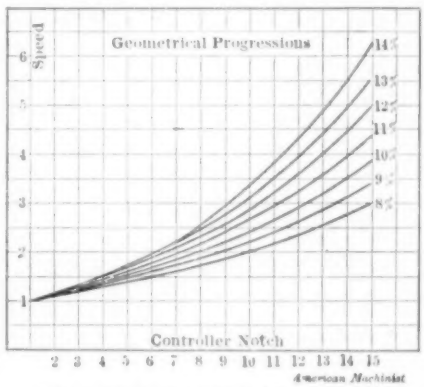
For this reason the variable-speed motor may in some cases actually decrease the cost of the machine tool by eliminating extremely bulky and expensive mechanical speed-changing devices.

*Based upon an article in December issue of *American Engineer and Railroad Journal.*

The following horse-powers which are mentioned in connection with machine tools of different sizes are based on a cutting speed of approximately 20 feet per minute, the assumption being that water hardened steels are used, and also that the work is done upon a normal machine tool, as distinguished from the modern high-speed machinery. Where the cutting speed is more than 20 feet per minute, the horse-power required should be increased approximately in proportion to the increase in speed.

The approved practise in the matter of cutting speeds is to make the ratio between the various speeds increase in geometrical progression, and as it is somewhat laborious to calculate in each case what the speeds will be on the controller notches, the curve shown in Fig. 1 has been prepared. This curve has been laid out on the basis of standard practise, in which the number of notches on the single voltage is eight, while on the double voltage fifteen notches are used.

The vertical represents the total increments in speed, the horizontal, the con-



RATIO BETWEEN SPEEDS AT CONTROLLER POINTS.

troller notches; while the curved lines each represent a certain percentage of the increase between the notches. For example, on the fifteenth notch of the controller having 14 per cent. increments, the speed will be 6.25 times the initial speed.

In general, the handle of the controller used in connection with variable-speed motors should be located convenient to the operator, as, for example, in the case of a lathe, good practise places the handle on the tool carriage so the changes in speed may be made without the necessity of the operator leaving his position at the tool carriage. Connection between the controller handle and the controller proper should be made as rigid as possible, in order that the notches on the dial of the controller may correspond as nearly as possible to definite running positions on the controller.

POWER FOR MACHINES HAVING ROTARY MOTION.

In general, the motors to be used for lathes, boring mills, drill presses, etc., should be shunt wound, variable-speed motors, with good inherent speed regulation.

1. *Lathes.*—Engine lathes using one cutting tool of water-hardened steel at about 20 feet per minute:

$$\text{H.-P.} = .15\ S - 1\ \text{H.-P.}$$

Heavy engine lathes, such as forge lathes:

$$\text{H.-P.} = .234\ S - 2\ \text{H.-P.}$$

In all cases S = swing of lathe in inches.

2. *Boring Mills.*—For the operation of standard boring mills using one cutting tool of water-hardened steel at approximately 20 feet per minute, the following formula will be found to represent good practise for heavy work:

$$\text{H.-P.} = .25\ S - 4\ \text{H.-P.}$$

where S = swing of mill in inches.

This formula applies more particularly to mills having a 30-inch swing and above. For smaller boring mills the formula as given in connection with heavy engine lathes will be approximately correct.

3. *Milling Machines.*—For normal milling machines using water-hardened steel cutters running at about 20 feet per minute, the following formula will be found useful:

$$\text{H.-P.} = .3\ W,$$

where W = distance between housings in inches.

4. *Drill Presses.*—For normal drill presses using water-hardened steel drills, running at a peripheral cutting speed of approximately 20 feet per minute:

$$\text{H.-P.} = .06\ S.$$

For heavy radial drill presses:

$$\text{H.-P.} = 0.1\ S,$$

where S = capacity of drill in inches.

MACHINES HAVING RECIPROCATING MOTION.

Machines of this character are from their nature less productive than machines having a purely rotary motion. For this reason it is especially important that machines having a reciprocating motion be run to the limit of their capacity.

This, of course, means a variable speed motor, similar to the motor described in connection with rotary motion machines, except that in the case of machines having a reciprocating motion the compound wound motor should invariably be used. The compound wound motor is useful in that at the instant of reversal, when the torque required of the motor increases very considerably above the normal, the compound winding assists materially in holding the inrush of current within reasonable limits; and this may be further improved by the use of a flywheel.

The following figures show average practise for the operation of some of the typical reciprocating machines.

1. *Slotters*—Normal crank slotters, using water-hardened steels at cutting speeds of from 15 to 20 feet per minute:

Stroke, Inches	Horse-Power.
10	5
18	7
30	10

2. *Shapers.*—Shapers using water-hardened tool steels at cutting speed of from 15 to 20 feet per minute:

Stroke, Inches	Horse-Power.
16	3
18	3½
24	5
30	6½

3. *Planers.*—For normal planers using water-hardened steel at cutting speeds of from 15 to 20 feet per minute:

$$\text{H.-P.} = 3\ W.$$

For heavy forge planers:

$$\text{H.-P.} = 4.92\ W,$$

where W = width between housings in feet.

The above formulas are for planers having a ratio of cutting to return speeds of approximately 1 to 3, and cover planers with two tools in operation. If more than two tools are used, or if the ratio between the forward and return speeds is more than 1 to 3, the horse-power given by above formula should be increased.

In connection with the above, it should be noted that where the machine tools in general are run under abnormal conditions, or in the case of abnormal machines, the only rational method of obtaining the horse-power is to make a careful study of the conditions under which the machine operates, to develop by means of suitable formulas the horse-power required at the cut, adding to this the horse-power required to drive the machine tool in question when running light. This latter method of analysis is based upon a large number of tests and requires, in addition to the formulas representing the horse-power at the cut, considerable experience in order that formulas may be properly applied.—*Electric Club Journal.*

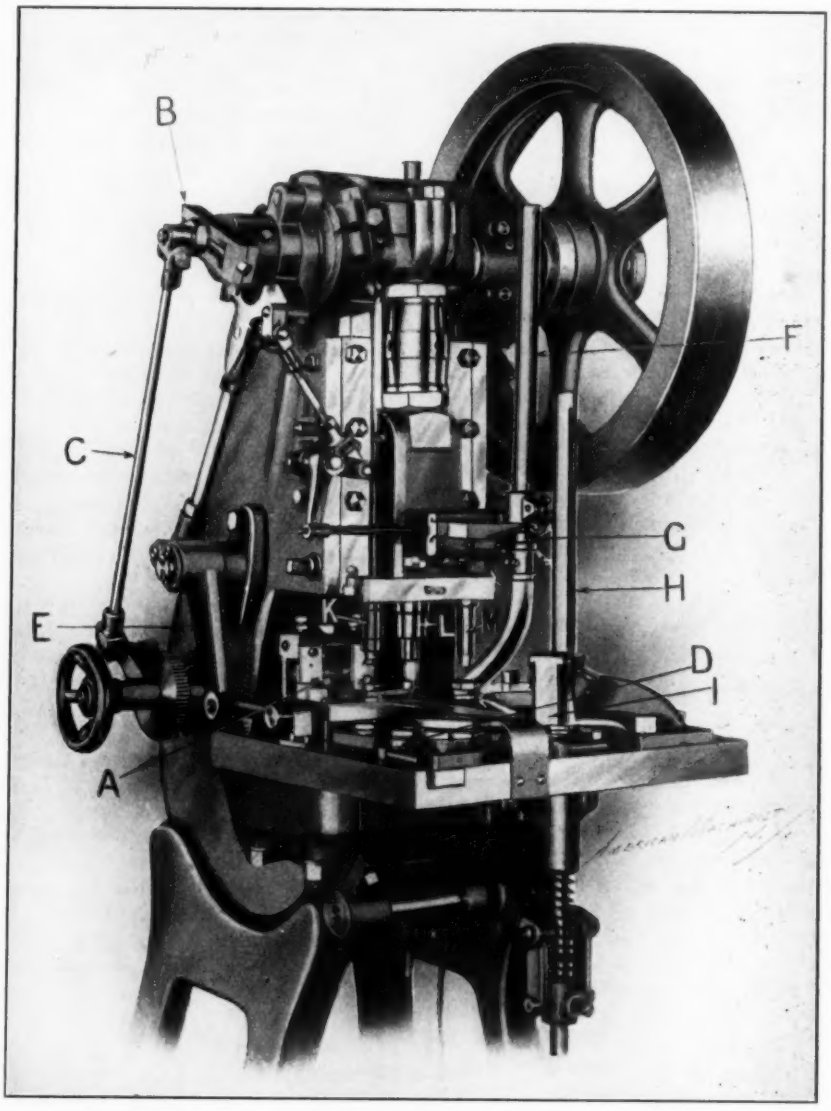


FIG. 1. A SPECIAL AUTOMATIC DRAWING PRESS.

A Special Automatic Drawing Press.

The variety of articles turned out by the punching and drawing press is now so enormous, and the call for the production of additional articles is so constant and numerous, that the devising of special machines or the arranging of special movements is now an important part of the work of the press builder. The half-

tone, Fig. 1, shows one of these special presses recently built by the E. W. Bliss Company, Brooklyn. The special lifework of this machine is the making of the cap *W*, Fig. 2. This cap is made from sheet tin, which is automatically fed from a reel by a single roll feed *A*, Fig. 1, to the blanking die, the punch of which is seen at *K*. The blank falls into one of the pockets of dial feed *D*. This dial feed, automatically rotating, then carries the flat blank under the drawing or forming punch *L*, producing the cap *W*, Fig. 2. Previous to this the tube feed *F* has been filled with aluminum shells, like *X*, Fig. 2. The third operation forces one of these aluminum shells *X* into a cap *W*, already formed, and makes the complete bottle cork *Y*. This piece being taper, with the large end upward, it cannot fall thru the die, and the vertical tube *H* is placed to receive it. After the dial has moved around to its next position the finished shell is shot up thru tube *H* by the action of the spring and plunger below. The roll feed *A* is operated direct from the shaft by the adjustable connection *B* and rod *C*. The dial feed is operated by bell crank *E* from a cam on the shaft. *G* is an automatic cut-off which allows only a single shell to pass thru the tube into the

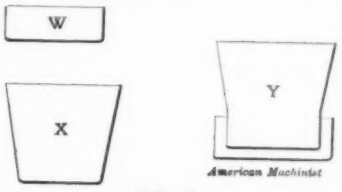


FIG. 2.

die. *I* is an automatic stop which prevents the finished cap from pulling back. *K*, *L* and *M* are the blanking, drawing and forcing-in punches respectively. A treadle lock is provided which allows the press to run continuously and to stop when this is released. It will be seen that the accurate timing of the successive operations in relation to each other is essential. The press makes eighty complete articles per minute, and is said to do the work of six men working under former arrangements.

Legal Notes.

BY E. P. BUFFET, LL.B.

An instructive case involving the relations between a manufacturing company, a contract, or piece, workman and a subemployee hired by the latter has been passed upon by the Appellate Division, New York State, Fourth Department, reversing a judgment in the Supreme Court of Oneida County. Theodore Koslovski had been employed by the International Heater Company to operate a tumbling barrel for cleaning castings, at the rate of 3½ cents per hundredweight cleaned. The head at either end of the tumbler was made with a flange to which the iron staves were bolted, and in order to permit the castings to be put in or taken out it was necessary to unbolt several of the staves. According to the finding of the jury, the heater company had agreed to keep the tumbler in good order. Koslovski hired two men to help him, paying them himself. It appeared from the weight of evidence that one of them, named Felix, had the principal and immediate charge of the work and looked after the removing and placing of the staves and adjustment of the bolts, Koslovski assisting him when necessary. Once while Koslovski was thus assisting Felix to take off some staves, one of them became loosened and fell on Koslovski's foot. Hence he brought suit against the heater company for damages on the ground of negligence. The jury found upon conflicting evidence that the accident had happened because the thread of the bolt was worn and allowed the nut to slip off. They awarded Koslovski $3,500 damages. The appeal court in reversing judgment upon the verdict and ordering a new trial rests its opinion largely upon the fact that, altho Koslovski might not have been aware of the defect, so as to be guilty of contributory negligence in fact, yet legally he must be held guilty of it, since Felix must have known of the defect and danger of the tumbler and Felix was acting as his agent.

"It is not an unfamiliar rule," remarked Hiscock, J., delivering the opinion, "that principals are to be charged with the knowledge and responsibilities acquired and incurred by their agents while acting in the course of their employment. We do not regard it as a departure from well-settled general principles to hold that a principal who is engaged in managing a piece of machinery thru an agent and employee shall be charged with the knowledge and observation of his employee and be bound by the latter's assumption of any risks incidental to the use of the appliance.

"Upon the other hand it may be regarded as quite well settled that the contributory negligence of an agent will bar a recovery by his principal for the negligence of a third party." The third party in this case was of course the heater company.

The court also intimated that this case might perhaps have been taken out of the rules of negligence and regarded in a special light if the question of so doing had been presented. The plaintiff differed somewhat from an ordinary employee and was to some extent an independent contractor. He relied, as a basis of his claim of negligence, almost entirely on a specific agreement of the company to look after the machine, instead of the ordinary liability from employer to employee to furnish suitable machinery. It might have been urged that this agreement referred simply to keeping the machinery in condition to perform work, for failure in which the company would be liable in damages, but that it did not extend to personal injuries. This question the court did not have occasion to settle.

75 App. Div. 60.

For Centers of Power Outside our Large Cities.

We take the following from an interesting address by Calvin M. Woodward, chairman of section D at the recent meeting of the American Association for the Advancement of Science:

One of the most important openings for future engineering enterprises is the establishment of large power centers, not only where water power is available, but also where fuel is abundant.

Take, for example, the vast coal mines in the vicinity of the city of Philadelphia and those in the vicinity of St. Louis. In each case the power for industrial establishments and for all kinds of moving machinery, large and small, in use in the city, including the street cars and the rolling stock on all roads, can well be furnished by electrical currents from large generating establishments near the mines. Add to the above the establishment of gas works sufficiently large to furnish all the gas needed for illumination, for gas engines, for heating and cooking purposes in a great city. In the case of St. Louis those gas works should be near the extensive coal mines of Belleville and other coal-producing regions only a few miles from the city.

The effect of these two great steps forward upon the physical and sociological characteristics of a city can hardly be overestimated. The ultimate economy and convenience of such installations are enough to justify them. We have yet to learn how cheaply fuel gas and electric currents can be furnished to large concentrated groups of consumers. But omitting all questions of mere financial economy, what a saving in health, beauty and enjoyment! The London fogs which we hear so much about are produced largely by London smoke, and the prevention of smoke will to a very great extent be the prevention of the fog. I look forward to the day when, instead of a small volcano of smoke from a brick crater above every house, St. Louis will have all its heating and cooking done by gas, and all power will be furnished by electric currents, or by gas and combustion engines, both gas and electricity coming from the gas works and power plants at the mouths of the coal mines in Illinois. What an era of cleanliness and comfort this presages! This era of cleanliness will be brought about by the engineers. Hence engineering education must see to it that engineering students are prepared for their high mission. The proposed "Million Club" of St. Louis bears no comparison with a possible "Clear Sky Club." The former proposes to seduce 250,000 non-resident smoke-makers into joining the 750,000 smoke-makers already resident in St. Louis, thereby making smoke enough to shut out the sun entirely (they almost did it during a whole week last November). The "Clear Sky Club," on the other hand, will propose to eliminate all smokers by sending coal-burning power plants

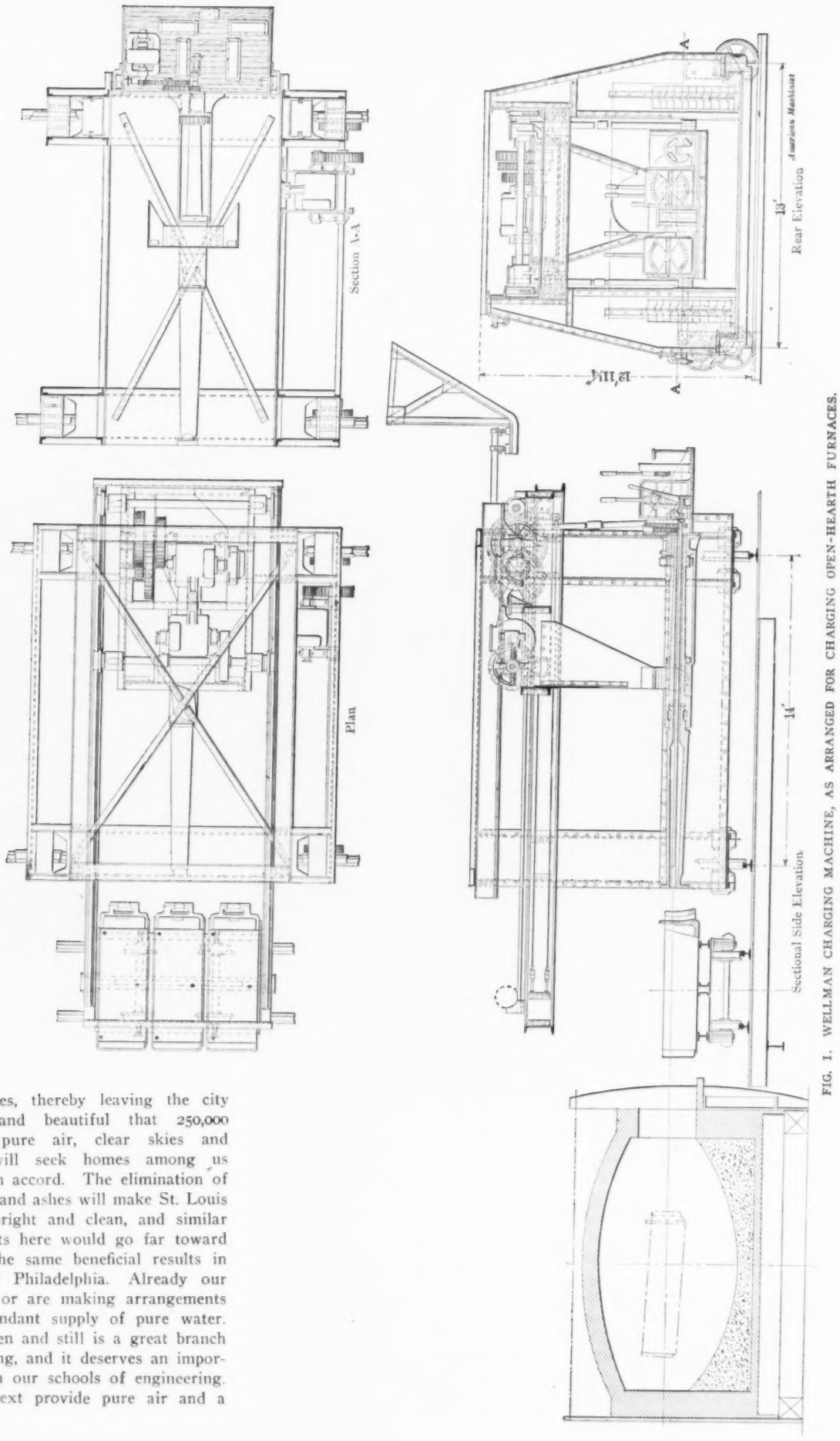


FIG. 1. WELLMAN CHARGING MACHINE, AS ARRANGED FOR CHARGING OPEN-HEARTH FURNACES.

to the mines, thereby leaving the city so clean and beautiful that 250,000 lovers of pure air, clear skies and godliness will seek homes among us of their own accord. The elimination of smoke, soot and ashes will make St. Louis absolutely bright and clean, and similar improvements here would go far toward producing the same beneficial results in the city of Philadelphia. Already our cities have, or are making arrangements for, an abundant supply of pure water. This has been and still is a great branch of engineering, and it deserves an important place in our schools of engineering. We must next provide pure air and a clear sky.

Notes on Cranes—The Wellman Furnace Charging Machine.

BY A. D. WILLIAMS.

The charging of open hearth and horizontal heating furnaces was at first done by hand, and it was very expensive in the time occupied as well as in labor. The material was handled by means of a peel or porter bar suspended from a crane, and a gang of laborers to manipulate the bar and counterbalance the load. The work was hot and dirty and required lots of brawn. It was hard to hold a gang on this work in hot weather, and the mill often had to wait. The vertical furnace was designed to avoid the trouble met in charging and drawing horizontal furnaces, but it was only a partial solution of the difficulty, as it was not adapted to heating and ingot heating furnaces. For open hearth furnaces the high and low types are used.

For open hearth service the stock is loaded in boxes which have a recess at one end, in which the end of the peel fits and can be locked by the operator. The boxes are dumped by turning them upside down, the peel for this purpose being rotated about its axis by a motor. For serving heating furnaces the peel is equipped with tongs arranged to grip the piece on its ends or sides, according to what it has to handle, the grip being released by power. The peel is carried in trunnions, and its end can be elevated or depressed by power acting thru a gear segment mounted on the trunnion, or a crank and connecting rod to its rear end.

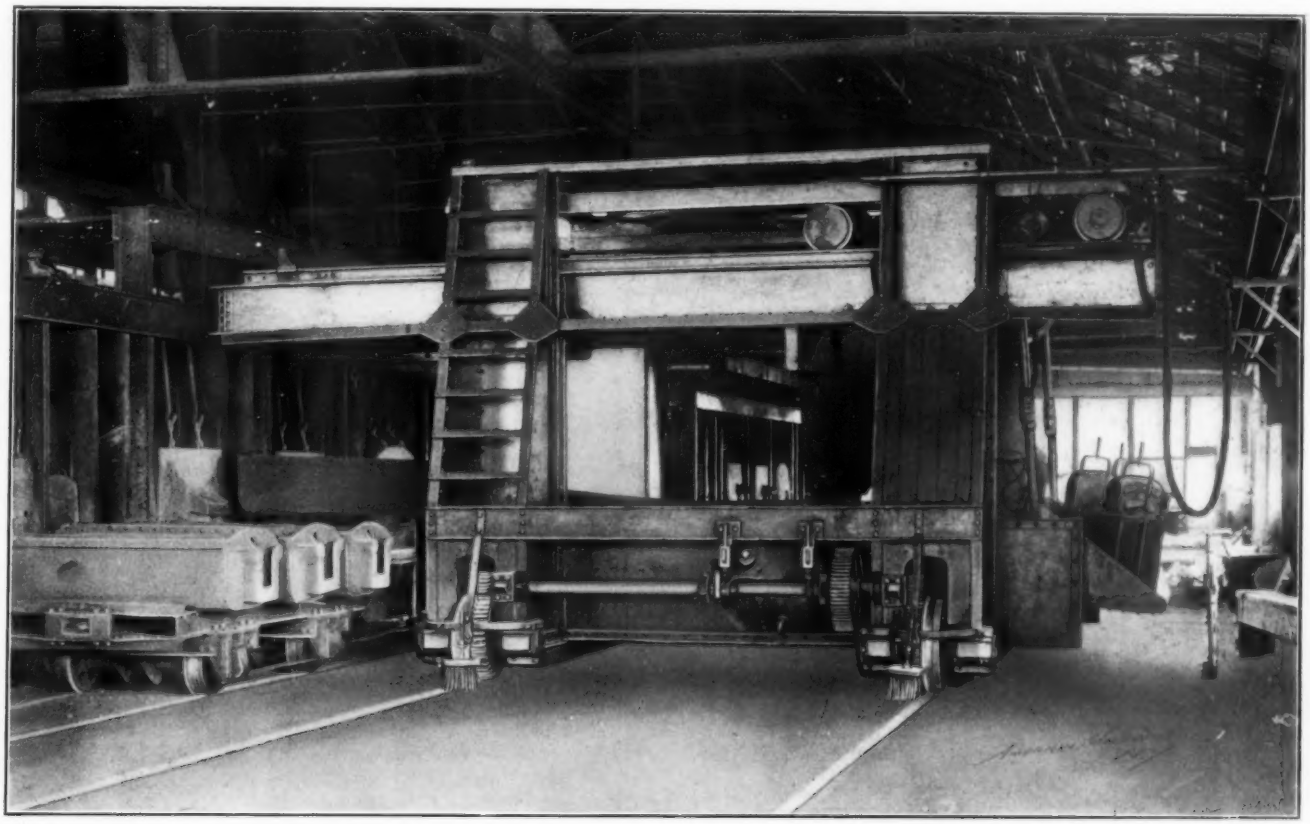


FIG. 2. HIGH TYPE OF CHARGING MACHINE.

slabs and blooms. Electric cranes reduced the trouble slightly, and in some mills the peel is still in use. The Wellman charging machine presented a solution of these troubles, and tho it was many years after the first one was built before it was recognized, it is now widely used and imitated, here and abroad.

TYPES OF THE WELLMAN MACHINE.

The early machines were naturally somewhat crude. They were operated by hydraulic power. Later steam-driven locomotive machines were designed, which were dirty and troublesome but speedy, and lastly came the electric drive. There are three types of horizontal charging machine, the overhead, the high and the low. All three are used for bloom, slab and ingot heating furnaces. The peel is carried by a trolley which is racked in or out by an electric motor. At this point the three types of charging machine differentiate.

In the low type the bridge or frame carrying the trolley is close to the floor, and the charging buggies run between it and the furnace. It requires a wider building than the high type, but when open hearth furnaces are to be charged with liquid pig metal a ladle crane can operate over a low charger to better advantage than it can over a high machine.

In the high type of machine the trolley runway is supported 8 or 10 feet above the floor level, and the machine is 13 or 14 feet high above the rails. The front ends of the trolley rails extend nearly to the face of the furnace, and the charging cars run underneath it. The peel is suspended from the trolley. This type is economical in regard to floor space and width of building, and hence is most widely used. Its hight, however, makes it impossible to operate a ladle crane over it, unless the building is exceptionally high.

In the overhead type the trolley is carried by a bridge on an overhead runway, and the peel is suspended beneath the bridge. It is supported by a turntable, so that it can be swung as desired.

In all these machines the bridge or frame can be traversed along the building to serve the different furnaces. The operator travels in a cab immediately in the rear of the peel, and in some machines is carried by the trolley and in others by the rear end of the peel. The front end of the peel and the grips which are exposed to heat are arranged for easy renewal. In addition to charging the furnaces the machine is often used as a shifter to move the charging buggies on their track, by engaging them with the peel.

THE HIGH TYPE OF MACHINE.

Fig. 1 is a general drawing of a high type Wellman charging machine, and shows the entire mechanism and operator's platform quite plainly. Fig. 2 shows the same type of machine, the charging boxes and car, one box having been lifted by the peel. This machine runs on rails set flush with the floor, and the brushes

in front of the track wheels are a necessity.

THE LOW AND OVERHEAD TYPES.

Fig. 3 shows a low type machine, and immediately over it is a 40-ton larger crane with a 10-ton auxiliary trolley, which is used for tipping the ladle. The ladle hooks are provided with a heel to hold the ladle and prevent its tipping the wrong way. This is a particularly fine view of an open hearth plant and shows the South Sharon Works of the United States Steel Corporation.

Fig. 4 shows an overhead type of slab charging machine in the plate mill at the Homestead Steel Works.

The machines shown are those built by the Wellman-Seaver-Morgan Company, of Cleveland, Ohio. The president of this concern designed the original charging machine when with the Otis Steel Company, of Cleveland.

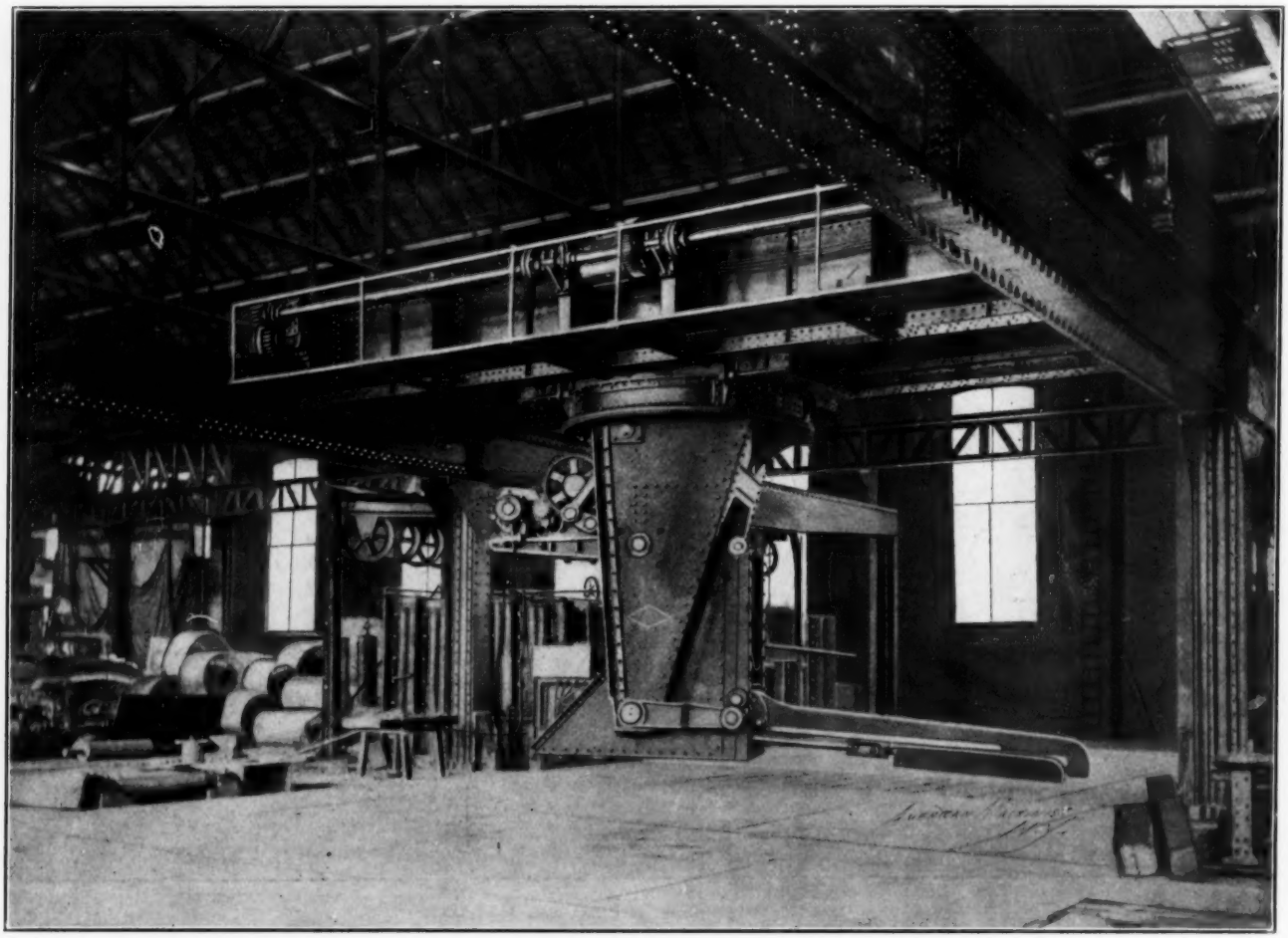


FIG. 4. OVERHEAD TYPE OF CHARGING MACHINE.

An officer of the United States Government is prohibited from issuing a duplicate check for any reason when the amount involved is more than $2,500. A check for $5,445.56, drawn by Pay Director L. G. Boggs, U. S. Navy, and payable to the Monongahela Iron & Steel Company has gone astray, and it has been necessary to introduce a bill in Congress for the relief of the firm.

Made, Self-Made, Unmade—A Review.

BY LEICESTER ALLEN.

Among the usual array of valuable and instructive matter contained in the AMERICAN MACHINIST, No. 48, Vol. 27, are two articles, not technical, but both so calculated to stimulate thought and to lead in the right direction the thoughts of young men aspiring to success in technical fields of work, that, to many readers, they will perhaps prove of greater value than the purely technical articles.

The articles referred to are "The Point of View in Engineering" (being an abstract from an address by Walter C. Kerr to the graduating class of Stevens Institute of Technology, 1904) and "The Practical Man in Danger," signed "Engineer."

Collaterally, the letter of Frank T. Carlton, on "Continuation Public Schools for Shop Apprentices" should be read and carefully considered, as it contains a useful suggestion and gives a clear view of the present industrial situation as it relates to apprentices, a class from which it is fair to suppose many so-called self-made men will emerge in the future of industrial progress.

SELF-MADE MEN.

The term "self-made" implies a process of making, and it also conveys the intimation that some other power or influence, outside of a man, can make him or unmake him. The term is applied, for the most part, in such an indefinite way that probably those most wont to use it would be puzzled to define exactly what they mean by it. If we say that a man, starting life with very limited resources, and who, without other resources or help except such as he could bring to his aid by his own personal influence, character and industry, has achieved wealth, fame or position, or all of these, is a self-made man, we shall probably express quite nearly the generally accepted meaning of the term. But this dismisses from consideration native tendencies, inherited capacity, and opportunity, none of which are under a man's personal control, but each of which is a vital factor in the making of a man of wealth, or fame, or of position. Many "a mute inglorious Milton," many a general who never wielded a more formidable weapon than a lumberman's axe, many an engineer who never executed any constructive work of greater magnitude than building stone fences around fields on the farm left to him by his father, rests under the sod of the little burying-place in the neighborhood of his birth. Our own land has produced a Porter (a name that will long live in the annals of engineering progress) who did not know he was an engineer till he had reached mature age, and

had comparatively wasted valuable years in the study and practise of law. Well, most of us know his autobiography, printed in these columns, how, by accident, he discovered his proper groove; how he felt the lack of an engineering education and applied himself to its acquisition at an age when most successful men are beginning to plow their deepest furrows; and he has told us of his failures, his disappointments, his successes. Now, he was a self-made man, if that name applies to any American, but who that with profound interest has carefully and reflectively perused his account of the discouragements and disappointments that buffeted and temporarily baffled him in his progress, does not see that it was the unconquerable spirit and will as well as the inventive and constructive ability, all of which were his birthright, that carried him forward to ultimate and brilliant success? Surely, these qualities were not acquired in the study and practise of law. But no man ever regretted more the lack of early training in his profession than Mr. Porter, or saw more clearly how many delays, misdirected efforts, discouragements and disappointments such training in a good technical school would have enabled him to avoid.

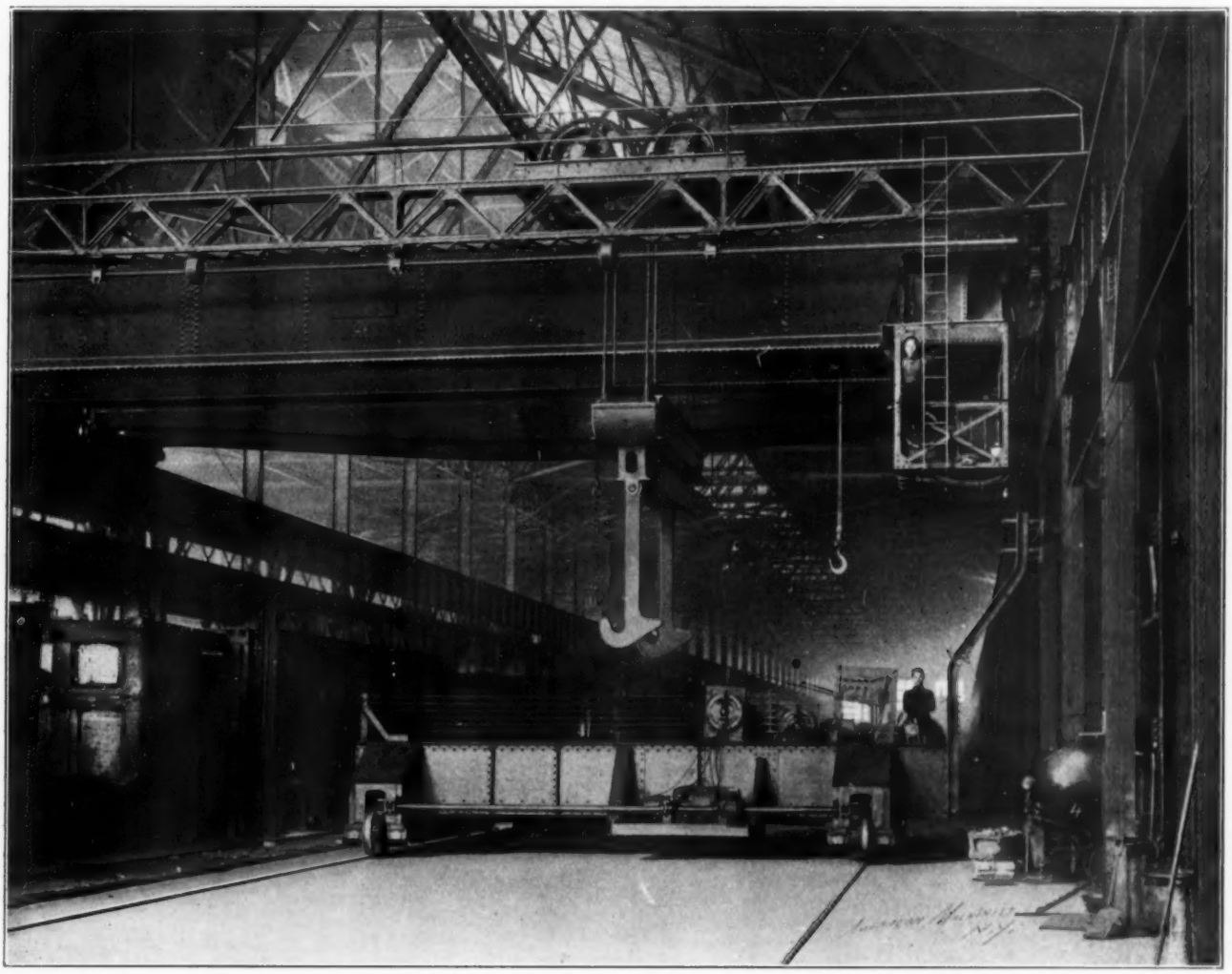


FIG. 3. LARGE TYPE OF CHARGING MACHINE.

TECHNICAL EDUCATION.

And here we reach the true inwardness of all the current discussion of technical education in its bearing upon the success or want of success of ambitious young men. Its value to the right sort of men is beyond estimate, but so many qualities which are not imparted by schools are concerned in success that, without them, no amount of such training avails. And the fact is that no man knows what he is made of till he puts himself to the test in practical work outside of the schools. With the right qualities we have seen, in the example of Mr. Porter, that marked success is possible without a technical course of instruction; and altho his career was remarkable, it is far from exceptional. History sparkles with the names of men who have succeeded without early educational advantages, and some of these names will always shine, while others that have been briefly illuminated will gradually sink into long obscurity.

The editor of this journal has justly characterized Mr. Kerr's address as "brilliant and epigrammatic." It is that and more. That portion which touches upon the possible ill effects of the combination of so-called liberal education with the non-academic, and the need of a greater infusion of "the spirit of engineering" into the courses of technical instruction as a preventive against the danger that engineering education will grow too academic, evinces a remarkable grasp of the subject and a clear insight into the trend of current technical education.

PRACTISING ENGINEERS AS TEACHERS.

The method proposed of having the technical schools enlarge their faculties by inducing men engaged in outside commercial engineering practise to devote a portion of their time to teaching, seems to involve serious practical difficulties. No doubt there are many engineers who possess ability to teach, as well as to practise, their profession. But to do anything preeminently well does not logically demonstrate the faculty of teaching others to do it. Other important qualifications enter into the make-up of a good instructor. It has been maintained that devotion to absorbing outside interests disqualifies, or tends to disqualify the mind for teaching, which occupation requires concentration of thought and energy as much as any other work. Moreover, teaching requires tact, patience, insight into psychological pecu-

liarities and habits of thought that many men dealing most competently with materials, mathematics and physical laws, do not possess in such a degree as to fit them for teachers. Another practical difficulty likely to arise is in the matter of compensation. The offices of engineers who would otherwise be eligible for such service are not, as a rule, located near the institutions wherein such service would have to be performed, and such men would of course expect the same pay for time going to and fro as for time actually spent in the classroom; besides, men of their class usually either command salaries higher than regular professors are paid or are in receipt of large incomes from their professional work. In view of these conditions, Mr. Kerr's suggestion upon this point does not appear to have been so carefully considered as other parts of his address.

USE OF LANGUAGE.

Upon the proper use of language in the engineering profession, Mr. Kerr makes some very pertinent and forcible remarks. An eminent instructor once said, in substance, that a man who cannot read understandingly in his own language that which is reasonably comprehensible, or write an intelligible expression of a clear idea which his mind is capable of formulating, is not half educated. Many of our technical graduates would fail if this test were strictly applied. Probably a majority of them would fairly meet such a test. It is a fact, however, that the use of clear, strong, concise language in verbal and written expression is measurably neglected in technical courses of study.

No matter what are Nature's gifts to a man, or what facilities for study wealth can put in his possession, neither of these, or both together, will make him a man unless he himself builds upon such advantages with persistent and well-directed effort. But, to build, one must have the materials to build with, and the foundation to build upon. It goes without saying that there are many students in the schools today who have neither the foundation nor the materials in such quantity that they will build to good purpose. They are in the schools because fathers who have never done anything of mark, nor, perhaps, up to the average mark, are hoping their sons will make a conspicuous mark in the world's progress. Neither parents nor sons are to be blamed. They are trying an experiment which does sometimes succeed. The failures are often very pathetic, rarely amusing.

But "Engineer," in his letter above cited, admits that "the technical graduate generally wins in spite of his handicap," which handicap he indicates in the following sentence:

INTUITION OR EDUCATION.

"If we could take the handy man's sense of mechanics and graft it to the technical man's brain, we would produce a wonder." Now, whence does the handy man derive his mechanical sense, and what is it when he gets it? Is it not a ready perception of fitness, or unfitness, of congruity or incongruity? Is it not the same faculty as Mr. Kerr means by what he styles intuition, and which he warns a graduating class not to undervalue? Does the mechanical sense in the "handy man" of "Engineer" get to be intuition after it graduates from a technical school? Is it not like our sense of touch, or our sight, cultivated and developed, growing with use and experience? Is it not comprised in the same category as what we call power of observation? Is it inborn? Do all in infancy possess it in the same degree? Does anyone have it in full measure when he begins to observe, to judge, to discriminate between good and bad, better and best? Or does it begin small, grow with our mental growth and wane when our intellect wanes, being only a germ at the outset and as much an acquired power as are any of our powers, all merely germinal in the infant brain? The fact is that our making is partly the work of our ancestors, partly our own work, partly the work of our environment; and no one can be said to be self-made except in the limited sense that, to win out, he made needed, persistent, strenuous effort. For effort cannot be put forth without opportunity, and equal opportunity does not come to all.

It is sad to reflect that many a promising young man whose natural powers, fortune, friends and opportunity, have combined to smooth the road toward a full, useful and honored manhood, has lacked the essentials of character to prevent his own unmaking. The shores of life are strewn with such wrecks of manhood.

Whether a technical graduate, or one who has graduated from the school of practical work, the man who can do something worthy to be done, and needed to further progress in industry, is, in the sense just indicated, a self-made man. "Engineer" speaks of the educated ass and the ignorant ass. The ignorant ass is the more tolerable, and the possibility that a man may receive either an academic or a technical education and yet turn out to be an unmitigated ass in the end is within the knowledge of most of us.

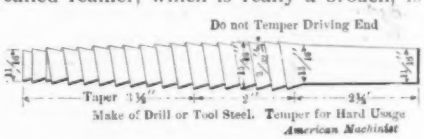
THE ATTAINMENT OF PERFECTION.

But what are we to understand by the term *worthy?* Mr. Kerr seems to think that worthy work is work that is right, "one hundred per cent. right" the first time it is done. Truly this is a high standard by which to measure the abilities and attainments of technical graduates. What a wonderful life could that man lead who, exempt from mistake, could do everything right—"one hundred per cent. right the first time." Shades of the mighty geniuses who have given us the steamship, the locomotive, the dynamo, appear and tell us, did you do your work right—"one hundred per cent. right the first time"? and has all we have supposed to be advance in the paths opened to us by your pioneer work been wrong? What machine ever invented was one hundred per cent. right the first time it was built? If technical graduates can reach such perfection as this, what do they need more? Experience with new devices and new designs generally reveals defects that demand some modifications in future construction. To get even approximately right the first time in difficult work is considered praiseworthy by some; and perhaps there might be found others that would testify from their own experience that such an approximation accomplished by a technical graduate just from his classrooms, without some further practical training, would be as unexpected as it would be gratifying.

Mr. Carlton's plan of continuation public schools for shop apprentices is based upon common sense, a broad knowledge of the status of shop education, and a wise appreciation of the power of the public school as a factor of human progress. It should meet such a warm approval from the principals of industrial establishments as to enlist their most earnest efforts for its practical realization.

A Broach for Bridge Work.

F. T. Darrow, division engineer of the Chicago, Burlington & Quincy Railroad, Lincoln, Neb., shows in the *Engineering News* of a recent date a form of reamer for enlarging rivet holes during the riveting of steel bridges. This so-called reamer, which is really a broach, is



BROACH FOR BRIDGE RIVET HOLES.

shown by the accompanying engraving and is made by cutting a spiral groove on the taper portion of the broach, as shown. This broach is driven thru the hole by a hammer, and Mr. Darrow says that it produces a good hole even where as much as ⅛ inch is to be removed by it, and that it does work much faster than the reamers previously used. He also claims for it that it does not give the swaging or thickening effect on the plates which the usual barrel drift gives, as it cuts the projecting edges away instead of staving them back, thus giving smoother holes and tighter plates. Tho this is probably new enough in bridge work, it is of course very old in shop work.

The Society of German Engineers has undertaken investigations which, it is hoped, will set at rest many conflicting theories respecting the specific heat of superheated steam. The thermal conductivity of steam is not yet known. It would appear, however, to be very low, since in the same space there may be present simultaneously water, saturated steam and superheated steam, an important fact when constructing superheaters.—*The Engineer.*

Letters to the Editor.

Experiences With Lathe Tools.

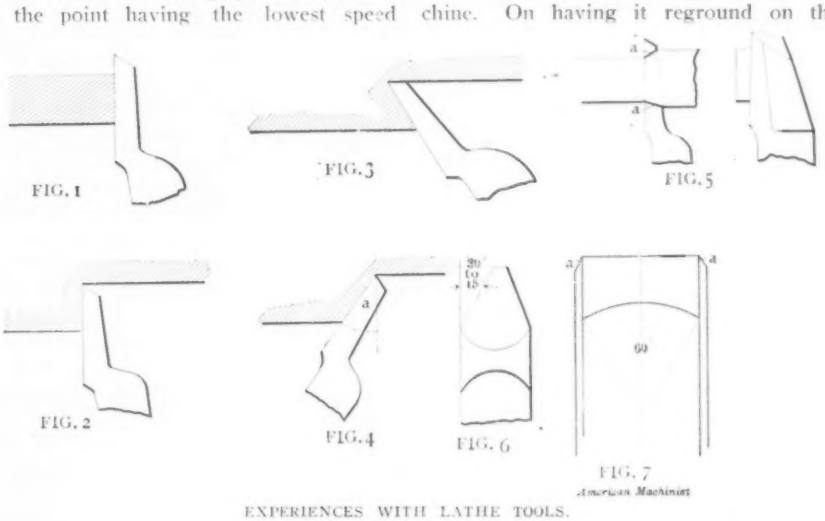
While an apprentice, my father bought for me a book treating on machine shop practise, in which the author complained of lack of positive knowledge of tools for cutting metals, and advised experiment. Since reading the book I have tried every form of tool I could think, hear or read of, and discussed the matter with every machinist I met who had an idea on the subject.

The solution is still ahead of me; but on some points I feel positive, tho lonely. Some months ago you published an account of some tests with high-speed steel cutting tools, with drawings of tools used. The experiments were evidently carried out on a lathe, and the edge of the tool was horizontal, inclined to axis of shaft 45 degrees horizontally, and from 10 to 30 degrees vertically. The point of the tool was said to be slightly rounded. The tool described is good, among the best; but why was the point rounded? and how much is slightly? I was taught to use such a tool, set above the center for parallel turning, but at the hight of the center for taper work. The reason for the different positions was not explained. Trial proved that cylindrical pieces could be turned as well with the tool at the hight of the center as above it, thus avoiding special grinding for each condition. I noticed in turning at high speed that the tool suffered more when it came in contact with the outside of the bar and at the point than on the part between; the former was readily accounted for, but not so the latter. If cutting speed determined it, the point having the lowest speed should wear longest. Making the radius of the point greater lessened the trouble; but as long as a straight part remained untouched by the outer skin of bar it held its edge better than the round part. Of course, in the case of a bar already freed of the outer skin or scale, the wear on the tool at that point was not increased. Evidence thus far favored a straight cutting edge for durability, and substituting a common side tool whose point is rarely rounded disclosed some of the trouble. Using it on a job, as in Fig. 1, in which the point does not touch, it works ideally. Use it as in Fig. 2 and the point fails in a short time; as in Fig. 3, and it is useless; use it as in Fig. 4 and the point lasts better. At an angle of 20 to 30 degrees from a right angle to axis the point does not fail under a moderate feed. Why?

An examination of the chips and what happens to them will leave little doubt. The tool crushes the metal in the chip, and it spreads in the direction of least resistance and takes a form like Fig. 5, if free to do so, as in Fig. 1. The heat generated is practically uniform throughout the chip and on the edge of the tool. In Fig. 5 the lateral crush is shown at *a a*, and is usually under 30 degrees. A tool set as in Fig. 4, with angle $a = 30$ degrees, will not cause lateral compression of the chip, and therefore will not generate more heat at the point than elsewhere on the edge.

A plan view of the roughing tool I have found to give satisfaction is at Fig. 6. Objection is generally raised to the corner, the claim being made that it cannot stand; but twist drills have each two worse corners and they give no trouble. Trial has demonstrated the superiority of a straight cutting edge in power consumption. I had an opportunity to test this point in turning some hard steel forgings. I set the tool to cut what was required at one cut and adjusted the feed to use all the power the belt would transmit with a tool ground on the Sellers grinder. When the tool became dull I touched it up on a wet emery wheel, but it stalled the machine. On having it reground on the machine, the belt was equal to its work again. Repetition produced the same result. This satisfied me that where it could be used the straight edge was the best.

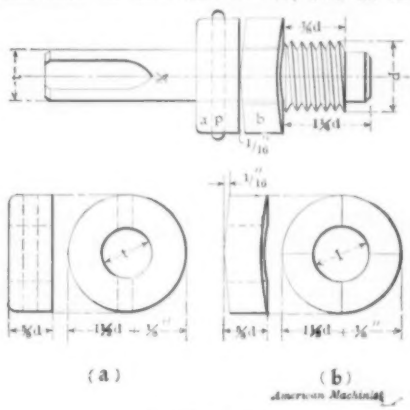
Strange as it may seem, this theory puts a curved cutting edge where a straight one is now universally used, viz.: on a cutting-off or parting tool. See Fig. 7. Everyone who has used such a tool knows the trouble with the corners. The chip cannot spread laterally, and its friction on the sides of the slot produces the heat necessary to destroy the corners. The remedy commonly used is an excessively fine feed. By forming the edge an arc of 60 degrees the chip does not tend to spread beyond the slot. In fact, I saw chips cut from steel casting which were narrower than the slot and the tools stood well. These conclusions are, after all, only general; the relation between the tool support and the cutting edge makes each case special. JAMES BELL.



EXPERIENCES WITH LATHE TOOLS.

A Nut Arbor.

In the small shop which prefers to tap and face its own nut blanks, and in the jobbing shop which has to get out nuts of all thicknesses as required, the nut arbor is a tool of considerable importance. However, considering the importance of squarely faced nuts and the vital relation they bear to the assembling of other parts going to make up a machine, and what disastrous consequences might result from the uncalled-for strains set up by an improperly faced nut, it is surprising how little attention is paid to the subject of nut arbors in some of the shops using them.



A NUT ARBOR.

The most common form, that of any piece of scrap stock with an end turned down and threaded, leaving a square (?) shoulder for the nut to bear against, is manifestly unsuited for the purpose intended. For, unless the nut *fits* the thread and the shoulder is square, it is next to impossible to square the nut, and if it is loose on the arbor, its high side throws it to such an extent that no improvement is effected.

Our shop had a motley gathering of nut arbors of this style, and none of them worthy the name. To replace them, I sketched out and made the set of thirteen, as shown by sketch, ¼ inch to 1 inch inclusive. The principle of the rocking collar has been applied to this purpose before, I understand, but in the hope of its benefiting someone I send it.

The parts were all made of tool steel. Both collars were hardened; the pin *p* was left soft. The arbor itself was hardened and tempered on the ends, the

threaded portion being left hard enough to insure the side tool not cutting it.

The dimensions are given in values of *d*, the diameter of the thread, which is also the thickness of the nut. The sizes marked *t* are the tap drill size or the nearest fractional size to the bottom of the thread, and size *l* is 1-32 inch larger. The length over all for the 1-inch arbor is 4 inches, while each size under that decreases in length ⅛ inch per size.

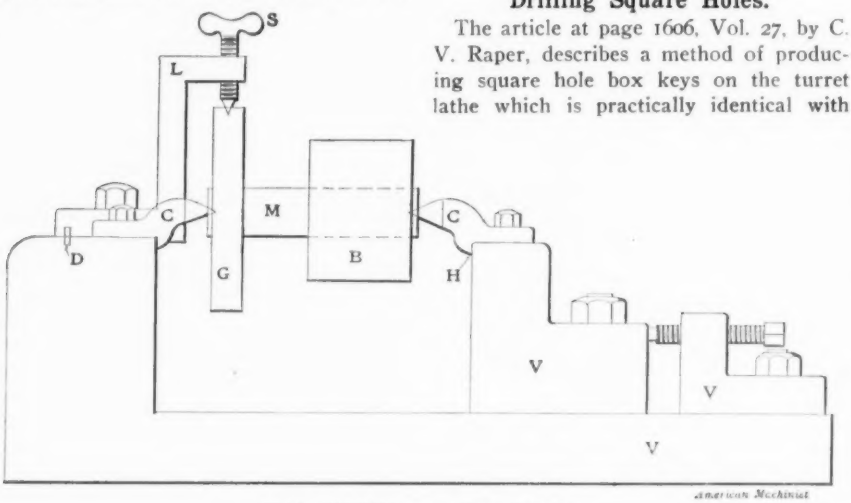
GEO. W. ARMSTRONG.

Gear Cutting on the Shaper.

The accompanying sketch presents to many, no doubt, an old friend in possibly different guise. I believe it to be, however, the most cheaply and easily made, as well the most effective, of any like device. It pulled me out of a tight place on one particular occasion, and if perchance my experience should be of service to any of the younger machinists this will not be time and space wasted.

I had been working but a few days in a contract shop which did not possess a gear cutter, having started on a small lathe about 14 inches swing and of ancient design, when in came the foreman with a rush order for a lot of 3½-inch round iron to be cut down to 2 11-16 inches. After glancing hurriedly round at the different lathes he came to me with half the order, giving the other half to the lathe hand on the new 24-inch lathe. I used the lead screw geared to about 3-32 inch lead per revolution for carriage feed, altho I had been previously informed that such practise was in decided opposition to the foreman's ideas, he being a believer in a lead screw for screw cutting only.

I was pounding the old lathe over the back for all she was worth—being considerably ahead of the big Swede on the 24-inch lathe—and had just started a cut



GEAR CUTTING ON THE SHAPER.

on my last shaft, when—r-rip went the small feed pinion which engages the one on the lathe spindle. Now, if there was any crime deserving of capital punishment in that foreman's estimation it was the abuse of a machine tool. After giving me a curtain lecture, he told me to finish the shaft and remedy the damage as best I could. I finished the shaft with the reverse pinion, using the belt feed. Then I turned up a blank the size of the broken pinion and cut the teeth on a shaper, using a rig similar to the one given. I was afterward told that the making of this pinion saved me from dishonorable discharge.

Letters in sketch: *V* represents a shaper or planer vise. *C C* centers made of tool steel, planed on under side, leaving a square shoulder at *H*. These are secured to the vise by cap-screws. *B* is the blank to be cut. The outer surfaces can be turned and faced in the lathe on mandrel *M*. *G* is index gear. I have always used a lathe change gear, one that will divide into the number of teeth wanted. This is held in position by the lock screw *S*, which in turn is supported by the Z-bar *L*, which is secured by means of a cap-screw and dowel pin *D*. This bar can be made adjustable very easily when different diameters of index gears are used, thus making the lock-screw *S* shorter and more rigid. The tool used should have a uniform side clearance, or it will have a tendency to crowd. On a brass pinion one tool only need be used, but on machine steel or wrought iron I would suggest roughing out the teeth with a square-nosed parting or cutting-off tool.

YANK.

Drilling Square Holes.

The article at page 1606, Vol. 27, by C. V. Raper, describes a method of producing square hole box keys on the turret lathe which is practically identical with the method used some fifteen months ago and since in the works with which I am connected. The tools we used, however, were slightly different, as the accompanying sketches show. We did not like the idea of the former running around the

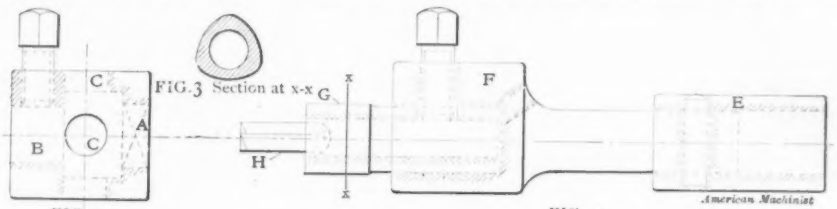


FIG. 1 FIG. 2

SQUARE HOLE DRILLING ATTACHMENT.

stock being drilled. *B* was bored to fit on the stock, and *C C* are holes to allow oil or other lubricant to reach the cutting tool. This former was secured by means of an ordinary right-hand thread set-screw, and not by a left-hand screw, as your previous illustration shows. Fig. 2 is the follower, *E* being a bush fitting the turret, *F* the holder for the follower *G* and the cutter or drill *H*. This holder was made to float in the usual manner adopted for reamers, etc., altho much more range of movement was given. The drill *H* was made from ⅜-inch round tool steel and the cutting end was milled triangular. C. V. R. seems to have gone to an unnecessary amount of trouble with what he describes as the "trihedral cavity." All that we found necessary was to grind the end of the cutter like an end mill, with, say, three teeth, by which means any amount of "backing off" could be obtained for any material.

There are one or two other points I would like to mention in connection with the previous article:

We did not finish our work completely on the turret lathe, finding it more profitable to drill the hole for the cross wire in the drilling machine. The movement at the end of the cutter, given as .02 inch, should certainly be more, for that does not represent the difference between the edge of the cutter resting on the flat side of the former, and the same edge then sliding into a corner as the former rotates. This should be nearer .051 inch. By having the cutter short and reducing the side of the triangle back from the cutting end, as in Fig. 3, the hole drilled would be considerably larger at the back than the front. (This would occur to a slight extent with the tools we used, but not so much.)

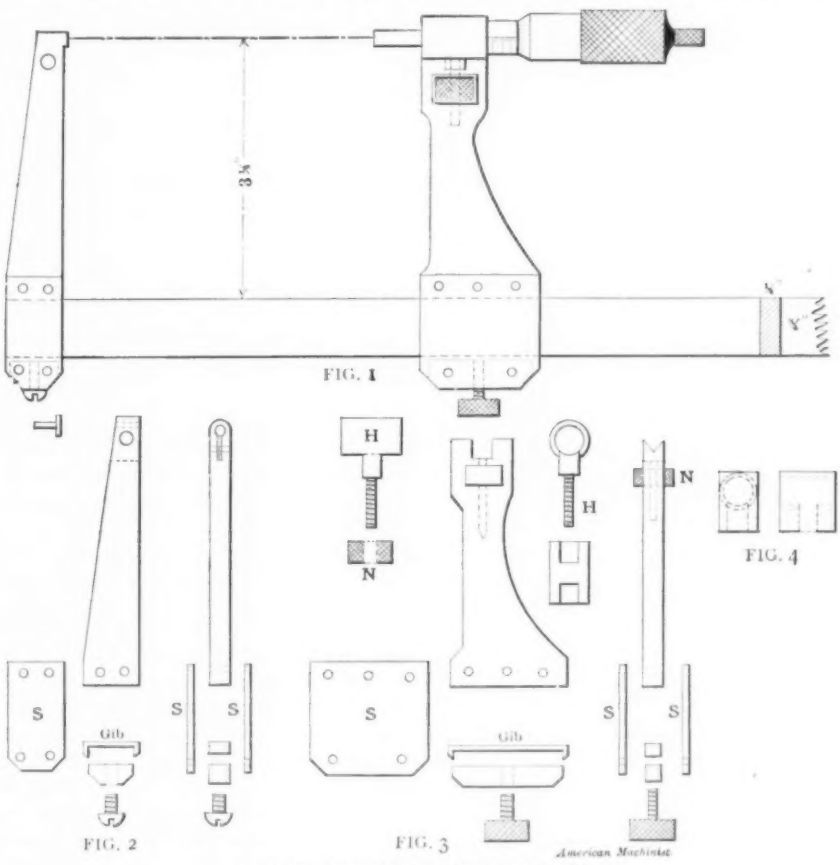
I doubt very much if the holes came out "perfectly" sharp in the corners, as stated. They may have been near enough for the purpose, but I fancy the real shape was nearer *W2* or *W3*, as actually shown by Mr. Raper. Is the time they took given correctly? If so, I should like to know the maker of the machine. I may say that, while we were able to get very satisfactory results, we could not do

them in anything like the time given. The statement that the method could be used in a drilling machine with equally good results is not correct if the cutter described is used, for this does not fit the square hole in the former in all positions, such as the follower I have illustrated does, and consequently the cutter would wabble all over the work. This does not take place when the cutter is used in a horizontal position, as in a turret lathe, the cutter always lying with its lower edge resting on the former.

Leicester, England. H. A. DUDGEON.

How to Make a Large Micrometer.

I often thought how handy it would be if I had a large micrometer. I could measure my work and tell just how much was to come off, and as most feed screws are graduated, it would be an easy matter to feed in so many thousandths, and the work would caliper just what I wanted it to. I happened to see a micrometer head at $3.50. It struck me immediately that it was just the thing I could use. After seeing this micrometer head I began to think that there was no reason why I should not make the frame and attach that head to it, then all it would cost me would be the price of the head. I started in, and in due time finished the micrometer, which I have since found so valuable that if I had to part with it and could not make another, I would charge so much that I would be enabled to buy one.



A LARGE MICROMETER AND ITS PARTS.

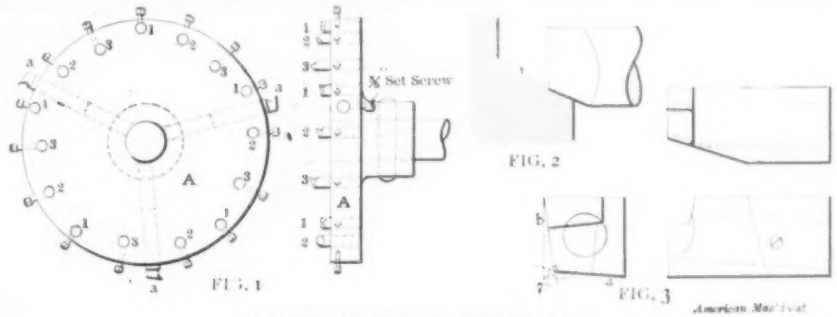
I think the following drawings will clearly show the shape and relative sizes of the different parts required. The beam and two carrier arms, Figs. 2 and 3, were made from drawn stock; the side pieces *S* were cut from sheet steel about 1-16 inch thick. Holes were drilled, and the parts riveted together with the beam between to keep them the proper distance apart. The riveting ought to be invisible after it is polished. The clamping device which holds the micrometer consists of a holder *H*, which by means of the nut *N* draws the micrometer down on the "V" cut on top of Fig. 3. The holder was made from a piece, ½x¾x¾, drilled and cut to shape, as shown by the dotted lines in Fig. 4. The screw was afterwards inserted and pinned. The advantage of having the micrometer detachable is plain, as it can be used elsewhere, for instance, as a depth gage. For accurate measurements distance rods are necessary. They can be made in the following manner: First, run the micrometer out, reading 1.000 against the anvil. Then run it back to zero and fit in the 1-inch rod. Next move the micrometer back and run it out, reading 1,000 against the 1-inch rod, and repeat the first operation, and by so continuing as many distance pieces may be made as would be desired. I would recommend copying shop standards, if any such are obtainable.

As both carrier arms are movable, they may be put on any length of beam; but the size for measuring 6 inches I think will be found most convenient.

CHRIS.

Inserted Tooth Milling Head.

Of the numerous inserted tooth cutters described in your valuable paper I have not seen any quite like one I designed.



INSERTED TOOTH FACE MILLING HEAD.

A, Fig. 1, is a gray-iron shaft coupling casting, 12 inches diameter (found loafing in the shop), bored to fit the machine spindle, faced on the front, key fitted, and holes drilled an easy fit for ¾-inch round bar tool steel and for ½-inch set-screws. The holes are drilled in sets of three as numbered on the sketch, all the holes numbered 2 being on a pitch circle ⅛ inch smaller in diameter than those numbered 1, and the circle of the No. 3 holes being ⅛ inch smaller than No. 2. They were spaced about 2-inch centers, making five sets. For taking a ¾-inch cut the No. 2's are set ¼ inch farther out than No. 1, and No. 3 ¼ inch farther than No. 2, as shown exaggerated in the side elevation. Fig. 2 is a nearly full-sized section of the cut, showing the No. 1 tool. This distribution of tools gives each tool an ordinary cut, as with a ¼-inch feed, there being five tools on each of the three cuts, each gets a ¼-inch cut and 1-20 inch feed.

To use the same head for boring I drilled 1-inch holes radially at *a a a*, Fig. 1.

Fig. 3 is a sketch of a jig for grinding the facing tools. First grind a flat on the tool for the set-screw, thus insuring the same position when setting in the head; insert in the jig and rest on side *a* to grind for side and end rake, the hole being on an angle, and then on side *b* for the top rake; no forging is necessary. To set the tools in the head I use a surface gage on the face, first setting all of No. 3, then No. 2 and No. 1 last.

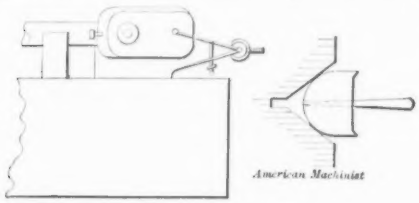
I have used this head removing ¾-inch gray iron at a speed of 12 turns per minute, ¼ inch feed per turn, or 3 inches a minute, finishing with a ⅛-inch cut. 18

turns, ½ inch feed, or 9 inches per minute, and boring with a ¾-inch roughing cut, 12 turns and .08 inch feed per turn. I think this is pretty good hogging for common steel. Of course the same feeds can be used with higher speeds

A. S. MACKENZIE.

Setting Crank Centers.

The most accurate way of setting crankshaft centers is to caliper from the surface plate to the center with a pair of ball-



LEVELING A CRANK.

pointed calipers at the crank-pin centers at each end of the shaft, as in the sketch.

MORTIMER PARKER.

[Ball points are often handy to have on a surface gage and would apply in this case.—Ed.]

A Filing and Drilling Jig.

The sketch shows a little rig which I saw used in a shop manufacturing electrical devices. It was for filing to length a lot of escutcheon pins. They were stuck in the hardened steel plate as shown in Fig. 1, and the other plate was fastened at the back of them by the four screws, and then the projecting points could be quickly filed off flush with the plate, which made them the right length. This

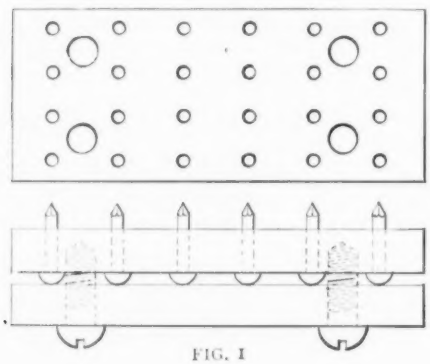


FIG. 1

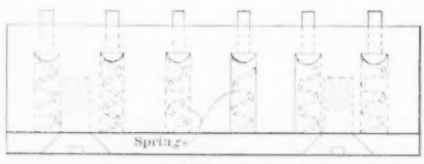


FIG. 2

A FILING AND DRILLING JIG.

plate also served as a jig for drilling the copper blocks shown in Fig. 2, in which the pins were mounted and held up by the springs, as there indicated.

D. WINKEL.

Single Lip Gun Barrel Drills.

Special machines to rotate the work and force the oil to the point of the drills are necessary when holes of great length in proportion to their diameter are to be drilled. For instance, 12-gage shot-gun barrels are from 28 inches to 36 inches in length.

The accompanying sketches of a single-lip oil tube drill illustrate a valuable form of drill for deep drilling. This tool cannot be started without being guided by a bushing, as it has no center; but this very fact is what makes it valuable for drilling holes of considerable depth.

Fig. 2 shows the drill ground ready for use. It will be seen at *a* that the center has been ground away, the cutting edge *b* is radial and a little less than one-half the diameter. The muzzle end of the barrel is held in a chuck, the butt being turned to fit a bushing in the steady-rest. While the barrel is rotated the drill is fed to the work automatically and the oil pumped

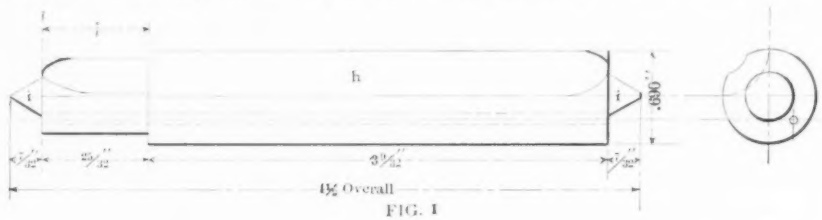


FIG. 1

FIG. 2

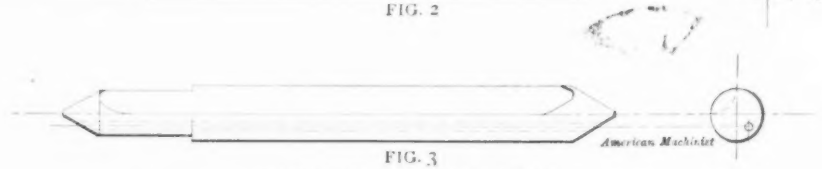


FIG. 3

SINGLE LIP GUN BARREL DRILLS.

thru the long, hollow shank extension and the hole *c*. The cutting lip removes the stock around the center, which is conducted away by the flowing oil, back thru the fluted side of the drill and shank extension. The center of the barrel is left as a core or wire. The ordinary drill with a solid center cannot cut the stock directly underneath the center, but must push its way into the metal ahead of the cutting lips; this is entirely overcome by the single-lip drill.

Altho the circumference of the hole is supposed to guide the drill, yet if the drill is not properly ground it will cut larger than its diameter. To obviate this, the cutting edge is brought to a point *e* at one-half the radius, forming two faces *f* and *g* of equal angles.

Fig. 1 represents the drill as it is finished by the toolmaker for a 12-gage shotgun. It is about 4½ inches long and .690 inch in diameter; this leaves .020 inch in the barrel to ream out to .710 inch for the muzzle and .724 inch back of the choke. A small amount may be lapped out, and if the barrels do not come smooth they are bored to .735 or .740 inch.

The drill is originally fluted as at *h* and the ends left with centers *i*. The shank *j* is turned somewhat smaller, and is not ground.

The driller grinds the shank to fit, and solders it into the shank extension. The point is ground off and the center ground out. The exact angle and clearance are obtained by grinding in a special fixture; they vary according to the different materials to be drilled.

Fig. 3 is an unground drill of smaller dimensions, but the principle of the finished tool is the same. E. PIERCE.

Commercially Perfect.

Mr. Osborne's "commercially perfect" is a phrase which I have been looking for for some time, and it recalls to my mind a remark which I once heard from an old man who had spent his whole life in the machine business. The old gentleman was one day finishing a square shortly after I had started in to learn the trade. I looked at him in wonderment for a while, and finally ventured to ask, "Will that square be perfect when it is completed?" The answer came immediately: "Young man, the perfect square has never yet been made; but if you get your work as near square as this square is, you will never have any complaint." If he had read Mr. Osborne's letter before that time, the answer might have been: "That square will be 'commercially perfect.'"

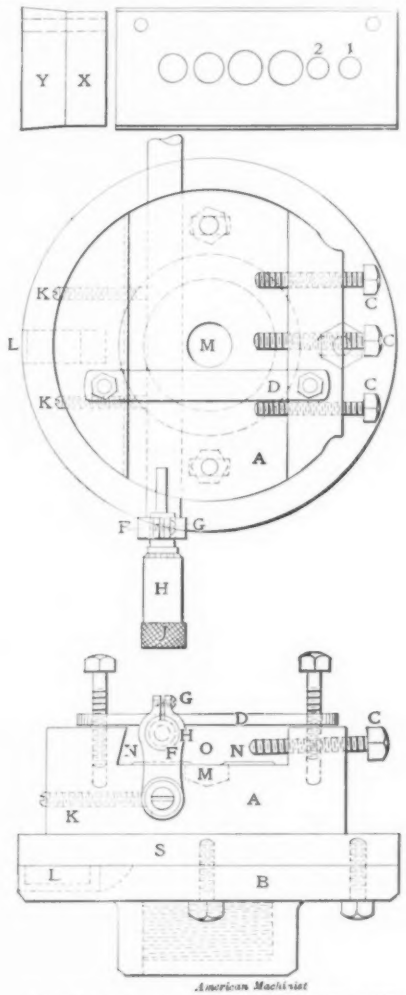
It seems to me that "commercially perfect" and "good enough" are closely allied, the whole secret being to know when a thing is good enough, and not to stop anywhere short of that point; and, on the other hand, to be sure to stop when that point is reached, my belief being that when that point is reached no amount of extra work will make it any better. It is just as much a part of a first-class man's

business to know when to do a rough, cheap job as it is to know when to do a fine one. The man who "gets there" is the man who studies the requirements and who puts in the work where it belongs, without putting in a lot of extra work where it doesn't belong. He is the man who thinks who strives to make his work "commercially perfect."

W. E. WILBER.

Jig for Spacing and Boring Die Blocks.

Fig. 1 represents a handy device by which our die blocks are held while being



American Machinist

JIG FOR SPACING AND BORING DIE AND PUNCH BLOCKS.

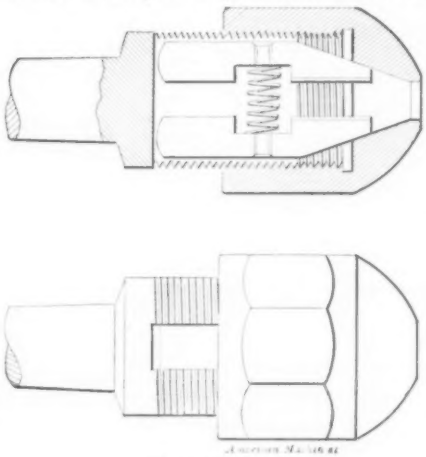
bored. *A* is a steel casting fastened to face-plate *B* by cap bolts. In boring these die blocks punch-holder *X* is doweled to die-holder *Y* and they are held on *A* and bored together. The die blocks are gripped by the points of screws *C C C* which are set at an angle which gives them a tendency to hold the blocks down. Clamp or strap *D* helps to hold the blocks together. *E* is a bar of cold-rolled steel which passes thru *A*. *F* is an arm held on the end of *E* by a filister head screw. *F* is bored at the top to admit a micrometer head. It is also slitted so that the micrometer head can be held tight by means of screw *G*. In boring the blocks the first or end hole is trued up and bored. When the blocks are set for this first hole the bar *E* is extended, and the micrometer head *H* is set to read one inch. The bar *E* is then set so that when *H* touches the end of the block it reads just one inch. Now, to bore hole No. 2. Suppose the distance from center to center is 7-16 inch. Loosen the blocks, adjust *H* back 7-16 inch, move the blocks along to touch *H*, then tighten on the blocks once more. In like manner all the holes are bored. Of course when *H* is adjusted back too far, it is set to the inch once more and started as at first. When the blocks are bored almost to the last hole, bar *E* strikes at the arm, and in order to adjust the last two holes the micrometer head *H* is reversed end for end and the blocks are adjusted from the face *J*. *K K* are two headless screws which hold *E* tight. These screws have small pieces of brass on the end so as not to mar *E*. On the back of *A* is a strip or tongue *L* which fits the slot in *B*. The holes for the cap-screws are elongated. This allows the jig to be adjusted up and down when truing up the first hole. The blocks can be rapped on either side, if necessary, when truing up.

I have seen George bore out a set of these blocks with nine holes ranging from 5-16 to 5/8 inch in size. When finished and tested, over all they were not more than .0015 inch out. *M* is a clearance hole for the boring tool and drill. The opening *O* is planed at the bottom, leaving bearing parts *N N*; this gives a better setting and allows the chips to get out of the way. The strap *D* is merely used to keep the blocks together.

PEDRO.

Drill Chuck.

The drill chuck shown is a good, strong tool easily made. The sketch I believe will be self-explanatory as to construction



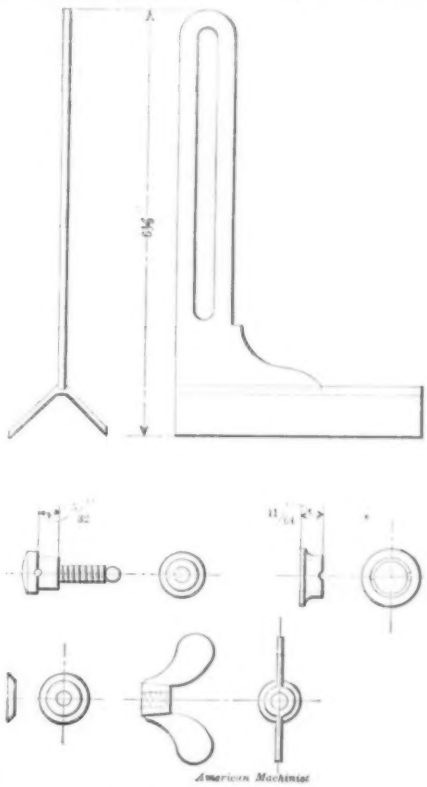
DRILL CHUCK.

and operation. The first one of this style we made was designed to take drills from 1-16 to 3/8 inch inclusive. The main point of advantage claimed for this chuck is that the drill can be firmly clamped, allowing no slipping of the drill and "chewing up" of the shank which causes so many drills to be thrown out before they are used up.

PAP.

A Novel Surface Gage.

The drawing shows a surface gage which is combined with an angle square. The angle square can be used either on round or flat surfaces. I have found it very handy for laying out, compared with the usual heavy stocked square. The large clamping washers bind firmly to the gage without any fear of slacking back while



American Machinist

A NOVEL SURFACE GAGE.

adjusting. It also does away with the danger and trouble of chips or dirt getting underneath.

RODERICK DHU.

Necessary Appurtenances for Fastening Work.

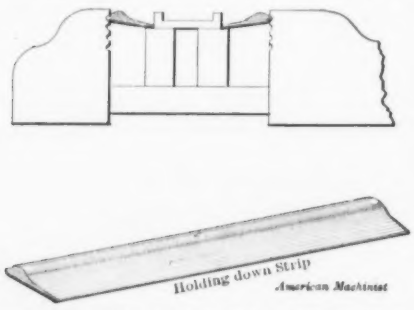
I was much interested in the description of the extensible planer clamp block described by J. S. Newbaker at page 21. This subject of clamping work on planers, boring mills, milling machines, etc., is one which could profitably receive more attention from shop managers than it does. While large sums are spent freely in all our modern shops for jigs, fixtures and devices for clamping special pieces to be operated upon in the machines, when it comes to supplying these same machines with proper bolts, clamps, chucks, wrenches, stops, drivers, heel blocks, etc., there seems to be a universal lack of interest on the part of foremen, who seemingly do not want such trivial matters brought to their attention. It is simply "Get it out somehow, and as quick as you can, and don't bother about the bolts. If they are too long, use plenty of scrap to fill up. If the heads are too small, stick a shim alongside to keep her from turning. Anything to get the machine going up to speed." No matter if it takes an hour instead of a

quarter of an hour to get started nobody knows the difference, "what we want is the blue, red-hot chips."

This was the condition in at least one large shop, where a hustler had been hired to increase the output. The work was mostly large and heavy and had to be clamped by the usual methods. Wood was used for drivers and bracing, and it kept the shop in an untidy condition. The output didn't increase in proportion to the repair bills. The next foreman was not long in seeing where the hours were lost. He had all the junk about the tools thrown in the scrap and had drivers made of turnbuckles with forked stub ends, gray-iron heel blocks, steel tapped sockets with T-heads fitting the slots in the machine and plenty of studs of different lengths to fit into them, these all kept in a box at each machine. The men appreciated this more than anyone else, and they showed it by the way they hustled out the work, actually increasing the output 50 per cent. over what it had ever been before. J. W.

Holding Down Strips for Planer and Shaper Work.

At page 1041, Vol. 27, is an article and a sketch showing a very good method of holding down work in shaper and planer vise. I have come across another method since, which I have not seen described or used in the ordinary shops, and I think is still simpler and does away with the heavy pieces in which the blades are inserted. One set each of long and short blades can be used to good advantage. Small, half-round grooves are planed 1-16 inch wide in the faces of both jaws of the chuck, and the round edges of the strips, if made to fit, will not kick up. The grooves, being small, do not injure work held directly against the faces of the jaws.



HOLDING-DOWN STRIPS FOR PLANER WORK.

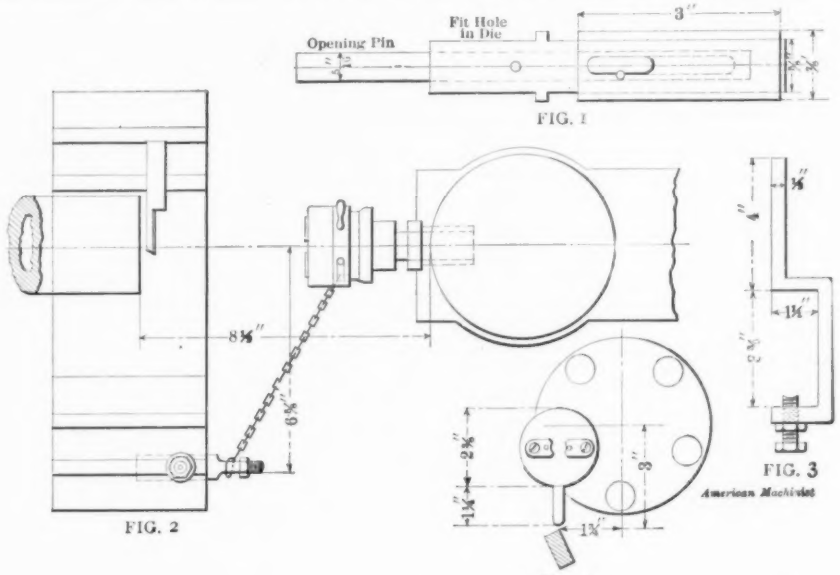
and the strips can be placed so as to accommodate different thicknesses of work and different hights of parallels.

A. J. De Lille.

Automatic Die Opening.

Altho the use of opening dies for screwing is very general, yet some makers of automatic machines make no provision for them. That it would be easy to do so is obvious. One hole of the turret needs to be large enough to take the sleeve in which the shank of the die-holder can slide freely. This is necessary, it being almost impossible to bring up the turret at the speed at which the dies will travel along the thread. Also a fixture must be provided to close the dies. In a well-known class of American-made automatics, with horizontal turret, we formerly used solid dies and reversed the spindle at each screwing operation. As we were using the Geometric Drill Company's opening dies on some other machines, I decided to alter one to suit. The holes in the turret were 7/8 inch, and the shank of the die-holder was 7/8 inch. This was cut off and replaced by the piece shown in Fig. 1, this being soldered in. Space was thus left for a sleeve, in which was fixed a key, the whole being an easy sliding fit on the new shank. The efficiency of the die is somewhat limited, the greatest length of thread now possible to cut being 2¼ inches. To close the die a piece of iron was formed as in Fig. 3 and fixed on the casting which supports the turret in a position quite clear of the other tools. In Fig. 4 the die has rotated to the next position after cutting the thread, has been closed, and the pin is clear of the stop. Since this alteration the reversing gear has never been used; in fact, the machine would be better without it. A special machine not being available, we often screw plain studs on a machine of another make, the turret of which rotates about a vertical axis, the dies being closed during the rotation as usual. The dies being the only tools used on this job, the turret need not be rotated if they can be closed by other means. This may be done as follows without making any expensive fixtures. A piece of mild steel as shown in Fig. 2 is fixed in the T-slot of the cross-slide. To this is attached a light chain, the other end of which is connected by a pin to a slotted stud in the die. When the cutting-off tool has just completed its work, Fig. 2, the chain is just tight enough to close the dies. During the other movements of the slide and turret, the chain is quite loose.

Wolverton, England. G. H.



AUTOMATIC DIE OPENING.

Carborundum for Dressing Emery Wheels.

At page 18, Vol. 28, interesting statements about the use of carborundum for dressing emery wheels are made, which, while correct, are somewhat misleading. While it is true that a stick of carborundum will answer to dress soft wheels, such as are made of emery, it will not answer to dress carborundum wheels properly.

It is just as true that a piece of very hard steel can be used for dressing emery wheels, but it will take more time to do it, and then the wheel will not be dressed as truly. The harder the material used for dressing a wheel the more correct will be the surface produced. Dressing wheels depends upon the relation between hardness of wheel and hardness of dresser. The economy of dressing wheels depends upon the time taken to do it and the cost of the tool used. A stick of carborundum costs little, but it wears away rapidly, and considerable time is required to do the work. A diamond is costly, but does its work very quickly and lasts a long time.

The work done by the diamond tool is very much superior to that of a carborundum stick, as while the former, when carried on a true slide, produces perfect cylinders, the latter, except when the greatest care is used by an expert mechanic, almost invariably produces slightly conical wheels. I can give instances of long use of diamonds to prove that the diamond tool, altho very high priced, is more economical than the cheap carborundum stick. Cases are known of diamond tools used entirely on 20-inch wheels, No. 36 grain, having lasted nine months without

wearing out or losing the diamond. These tools cost $25.

Losing a diamond is due to bad setting. If the diamond be of the proper shape, larger at the back than at the exposed end, and set by casting steel around it, there is hardly any possibility of losing it. In a first-class setting the diamond should be all but buried in the steel, which will prevent breaking off the exposed point accidentally. The grinding wheels will readily cut the steel away while the embedded diamond will do its work on the wheel. Of course when the diamond is merely staked in the holder, it is not firmly set; the holding material will be rapidly worn away, and then the diamond is certain to jump out and be lost. Everything depends upon a perfect setting, and Mr. Pitrot should try one to obtain proof thereof.

GUS. C. HENNING.

Cutting Spirals on the Planer.

The illustrations were reproduced from photographs taken at the Pioneer Iron Works, 149 to 163 Pioneer street, Brooklyn, where the cutting of these spirals is practically an every-day job.

A rack is mounted parallel to the travel of the planer on a bracket secured to the bed. This rack engages with a pinion mounted on a shaft at right angles to the planer, and supported in two bearings secured to the table.

The particular job for which this mechanism was devised was the cutting of internal spiral grooves in so-called "loose" eccentric sleeves for small engines, and also for the short external spiral sliding block which slides in these internal groov s and rotates the eccentrics on the shaft, thus reversing the engines.

A large bearing which is a working fit for these sleeves is secured to the table, its axis being in line with the travel of the planer. This bearing is shorter than the sleeve by the amount necessary to secure the bevel wheel seen in position in the illustrations. This bevel wheel engages with the bevel wheel on the shaft at right angles to the table.

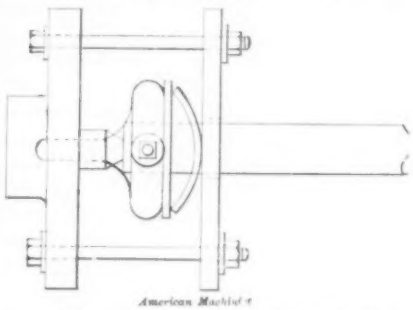
It is obvious that as the table moves back and forth the stationary rack actuates the gear wheels and oscillates the sleeve. The tool, as will be seen, is an ordinary extension tool with an inserted cutter. This cutter is of course shaped to the correct angle so as to "clear" the spiral as the work rotates. The tool and clapper block are wedged solid so as not to lift. The cutter is not on the bottom, but on the side, all the feeding being done with the cross-feed screw. This is done to avoid digging in and is entirely successful, the cut being as smooth as can be desired. The sliding block that works in these grooves is shown lying on the planer table immediately in front of the two bevel gears. When ready to cut these pieces the large bevel gear is removed from the eccentric sleeve and mounted on a mandrel which has a large part fitting the bevel gear and bearing. At the end next the tool there is a collar on this large part to take the thrust. Beyond this collar the mandrel is reduced to the inside diameter of the eccentric sleeve and a rectangular hole is made thru it at right angles to its axis to receive the sliding block. The sliding block is held in this hole, for planing, by a set-screw. The tool used to finish the sliding block is similar to those used for planing T-slots, with of course the necessary clearance so as not to interfere with the spiral. This tool also is fed from the side. It is said that in speed this method compares favorably with milling.

Fig. 1 shows the rack inverted for cutting right-hand spirals. Just over the pocket of the table at the extreme left is shown a sample piece of work; it is of gray iron 6⅜ inches long 2 5-16 inches outside and 1¾ inches inside diameter. It has six right-hand spiral grooves 5-16 inch wide by ⅛ inch deep cut on the outside, and six left-hand grooves of the same size cut on the inside. The pitch is about one turn in 11 inches. To the right of this job is shown one of the eccentric sleeves with the spiral cut in it. To the right of the eccentric sleeve is shown another sample job with six internal left-hand grooves. After grooving the outside was turned off, leaving three rings to support the spirals.

DIXIE.

Holding Steady-Rest Work on the Live-Center.

At page 1617, Vol. 27, is an article on the above subject by "Apprentice." This is no doubt a problem too often carelessly solved. The device referred to is no doubt a simple way of holding the work and may be "good enough" for ordinary work, but a little strain will certainly have to be put on the hook and that will no doubt tend to spring the work slightly. Then in case your lathe is not absolutely true or your steady-rest placed absolutely central, the distance between the point where the dog is clamped and the face-plate will vary at every turn, thus springing the shaft more or less at every turn, and rendering accurate work impossible.



HOLDING WORK ON THE LIVE CENTER.

I have met with good results in applying the arrangement herewith illustrated and consisting of a bent washer resting on a straight one and equalizing the pull of

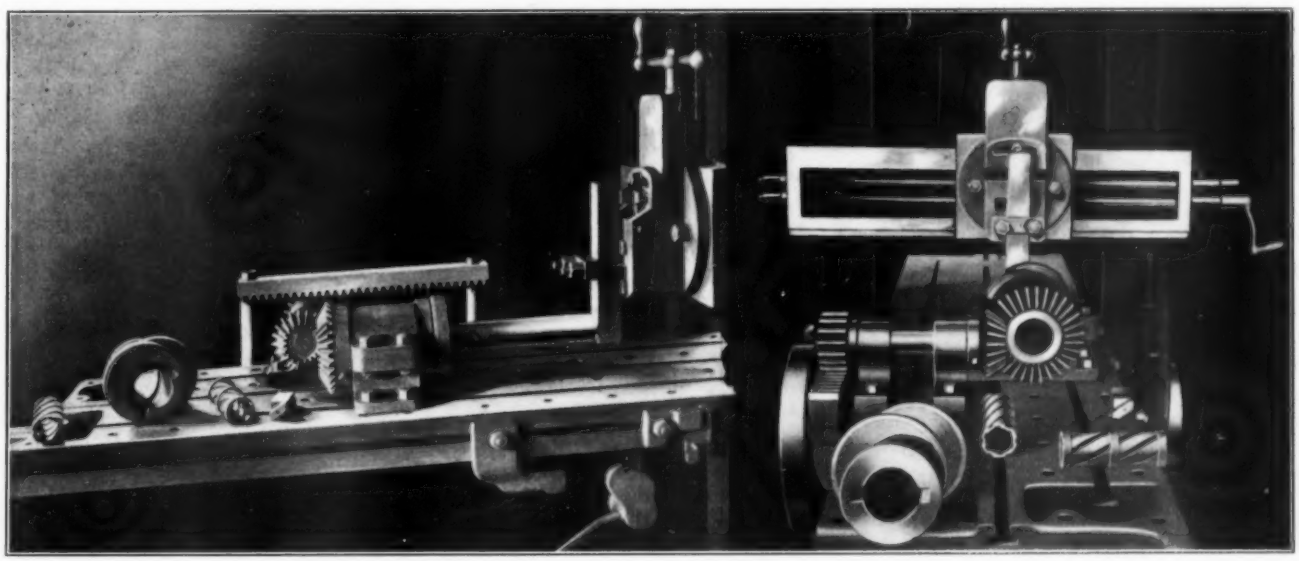


FIG. 1. PLANER SET UP FOR RIGHT-HAND SPIRALS.

FIG. 2. PLANER SET UP FOR LEFT-HAND SPIRALS.

the bolts on the clamp, which is a piece of flat iron having a hole drilled thru to clear the work.

APPRENTICE "J. A. S."

Uncertain Action of Steel in Hardening—A Tap-Making Kink.

I read with great interest "Tap Maker's" experience with taps, at page 26, and it leads me to give my experience in hardening tool steel. Most of the taps that I make are special taps, and I certainly do have some troubles of my own. In some cases I find the variations to be very great in taps made from the same bar of steel and heated to as near the same heat as possible in a charcoal fire, which I find best. In one case which I had not long ago I made a tap ⅞ inch diameter with 18 threads to the inch, and I found upon taking it from the bath that it had decreased in diameter and in length also; but in most cases I find that taps will shrink in length and increase in diameter.

Having tried steel from most of our United States manufacturers and two brands of English steel, I can say that it makes no difference who makes the steel or how high or low a piece of steel may be, there is always a variation of some kind, and in some cases where you least expect it. A short time ago I was given a round die with a 3¼-inch hole to harden, the steel being one inch in thickness. Imagine my surprise to find it after hardening about 3-128 inch larger at the top than at the bottom of the hole. I could not solve that problem, as I was, and always am, very careful to get a good, even heat. I would be very glad if some of your readers could explain the cause of that.

I find in making taps for malleable iron work that if a tap is made 1-64 inch larger in diameter, the bottom of the thread being the same as the sample screw, it will save lots of trouble, as malleable iron always leaves lots of small chips which cause the screw to bind. In lots of cases I have had screws stick fast when the taps were made the same diameter (outside) as the screw. The 128th inch on each side gives clearance for chips, and I have had very little trouble since making my taps that way.

I hope to have the pleasure of reading some more about the difficulties of tap makers, as it is a very interesting and instructive study. H. H. B.

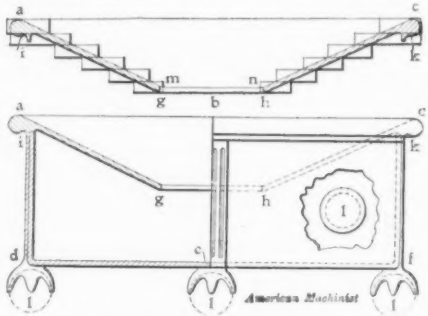
Making a Thin Pattern.

The hardest job we have had to tackle of late was the making of a pattern for the article here shown. It had to be round in shape, cast in brass, and nowhere more than ⅛ inch thick. There were to be patterns for three separate parts—the receptacle proper, the cover and the brass ball.

A pattern so very thin must be made exceptionally strong, not only to draw but also to retain its proper shape. There remained nothing to do, in building the receptacle pattern, but to take a thin, flat piece for the bottom *d f* and upon this to build the wall *i d* in segments, using half a dozen thin courses. This we knew would give the strongest kind of structure and avoid liability to warp. In making the cover also we had to proceed in the same way, building it of six thin courses of segments, as shown in Fig. 1.

With these glued up our troubles, instead of being finished, were just about to begin. The turning was a delicate job to undertake. We fully realized that with a piece so thin, if the tool accidentally slipped and caught, the whole thing would fly into splinters. The first operation was to fasten the piece firmly on the face-plate and then proceed mincingly to turn the inside. The tools had to be kept exceptionally sharp and the cuts were very slender. Of course it was a slow way of getting along, still it was the only safe way. We had to proceed with the same care on the outside, leaving the wall when finished only ⅛ inch in thickness, with a slight draft on each surface.

In turning the cover after finishing the inside *a m n c*, we had to rechuck the piece. We turned the surface of the face-plate



A JOB OF THIN PATTERN WORK.

so that it would fit perfectly and give a firm backing for the part already turned.

The next step was to turn the cups to form the claws for grasping the brass balls. This, however, was not difficult, the real hard part being the subsequent marking of the claws and carving them out, and it may be well to add that, since these claws had to be lifted up in the cope, they could not be fastened permanently on the receptacle, but had to be simply attached by means of pins or stems turned on the upper end.

When all the different parts were finished and put together, the pattern presented a most attractive appearance.

HOMO.

Non-Productive Labor.

While agreeing with your remarks *re* non-productive labor (at page 1486, Vol. 27), I notice that you do not suggest a term in place of it. Possibly you have experienced a difficulty in finding a suitable term for this class of labor which will convey the correct impression to the lay mind.

It is essential for cost keeping that there should be a distinction between the money spent on producing a piece of work and the money spent incidental to producing it, and any term or word used to describe the money spent incidentally in producing it, must convey the same meaning as non-productive labor now does to those who understand it.

I have suggested "establishment charges," "departmental charges," "sur-charges," "incidental labor," etc., but all seem to convey the idea of unnecessary labor or charges. Establishment charges seems to be the best term, but the cry is still the same—"Keep down the establishment charges."

I think the whole trouble lies with the system of costing. In most works it is the usual rule to analyze wages paid to the broad headings of "productice" and "non-productive" wages, and make no comparison with the week's output. By this it is possible to show an increase in the wages paid for non-productive labor, thus showing an apparent loss, but a comparison of the week's output shows a corresponding greater increase, which reduces the average cost per article. The same thing applies to consumables, such as oil, suds, waste, loose tools, etc. By a miserly use of these the average cost per article can increase and not decrease.

As long as the cost office is considered part of the counting house and run by an accountant having no practical experience, and over whom the works manager has no control, it will be an hindrance and not a help to management, by giving a false impression of figures and facts.

I think the works costs should be directly under the works manager's control and in giving information to the general management's works cost *of piece only* should be used as a basis. What material difference does it make to the success of the firm as to what works costs consist of if the average cost per piece is decreasing? What advantage is it to the salesman to know how the cost of the article he is selling is arrived at, to know what percentage of the following items each price consists of—labor, material; foremen's, toolsetters', laborers', storekeepers', timekeepers' and clerks' wages; managers' and draftsmen's salaries; rents, rates, taxes, gas, coal and general consumables; plant and works maintenance; patternmakers' and toolmakers' wages; insurance fees, patent fees, directors' fees, etc.?

For works managers the above details are of peculiar value, especially if such charges are analyzed and treated departmentally. He can then decide where additional "non-productive" labor will cheapen cost, and where to effect an economy. Not only should cost keeping help management, but it can show if necessary that whereas the works are making a profit, selling and trading expenses convert it into a loss.

I am inclined to agree with the proprietor in his fad of keeping down the percentage of non-productive labor, especially as he understands it. A moment's consideration of the above details that go

to make up the cost of the article will show that bare cost of labor and material is only a small percentage of the total cost. This gives the greater portion non-productive and therefore more scope to economize. But on the other hand the smallest *net gain* on labor cost is multiplied as a works cost.

I consider it part of a manager's duty to show by actual figures that the so-called extra "non-productive labor" is cheapening the cost of the piece under consideration, and not assume that up-to-date methods naturally cheapen an article. Of what advantage is it to spend £20 in tools, etc., that will effect only 1 shilling saving on each piece if there are only 200 of such articles to be made?

Again, I will assume that the present works cost of a factory is £1,000 a week with an output of 500 articles. By engaging toolmakers, etc., the weekly bill totals up to £1,200 and the output increases to 640 a week. Now, under the first condition each article cost £2 while under the second condition only £1 17 6, thus showing a gain of 2/6 on each article, owing to additional "non-productive" labor." On the other hand, a reduction in consumables and non-productive labor to bring a total of £900 a week and a corresponding decrease in output to 432 would show an average cost of £2 1 8, being a loss of 1/8 on each article made, owing to reducing of consumables and non-productive labor. I have come in touch with many instances of managers' judgment being at fault simply because they had no data on which to base their opinions.

But still such times as cost offices use works cost as a basis instead of bare cost I should be very glad of a term which will convey the idea desired better than "non-productive labor." A. THOMPSON.

England.

Diameter of Hobs for Thread Dies.

In looking over Mr. Markham's articles on the making of hobs for chasing machine

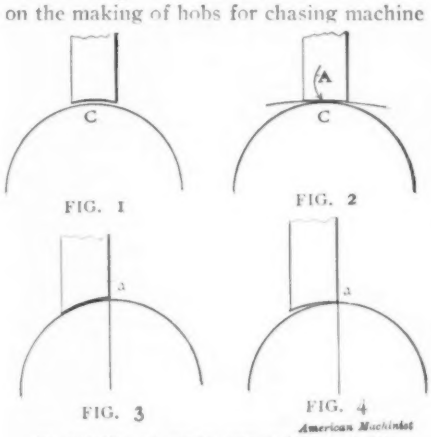


FIG. 1 FIG. 2

FIG. 3 FIG. 4

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DIAMETER OF HOBS FOR THREAD DIES.

dies, I noticed the following which does not seem clear to me. He says: "In the making of hobs for cutting adjustable dies such as are ordinarily used in screw machines the hobs are usually made from .003 to .005 large. The extra size gives relief to the threads of the die." I do not see how this is possible and would like to know what some others think about it. Suppose we take, for example, the commonest form of adjustable dies, those used on most bolt machines.

In Fig. 1 if the hob is turned to exactly 1½ inches the radius of the die will be the same as that of the screw to be cut and will cut freely. Fig. 2 is a die, much exaggerated, made as per Mr. Markham's instructions. Let the circle *C* represent the diameter of the hob and *D* one of the four cutters in the die head. If these dies are chased with a hob larger than the screw, what will prevent the dies binding at the point *A*? GEO. FAIRMONT.

[Figs. 3 and 4 will probably make the matter clear without explanation. In both of these the cutting face *a* is radial and in Fig. 3 the radius of the circle cut by the hob is less than that of the screw to be cut, while in Fig. 4 the radius of the cutter is greater than that of the screw, and the clearance in this case is sufficiently evident. Both sketches are of course exaggerated. —Ed.]

"Scraping That Would Pay But Which Will Not be Done."

Since your article on the above subject appeared at page 170, Vol. 27, I have read each subsequent issue, expecting that some one of the many whom I have known to have had similar experiences would come out with something to say about them. The single item of experience in the editorial referred to is identical with that of many a would-be progressive mechanic on going into a strange shop and trying to apply methods learned in other factories to its particular line of work, and my impression is, after several years spent among mechanics of three foreign countries, that in this respect no exception should be made in favor of our own.

About twenty years ago, with several other toolmakers, I followed a well-known engineer to work for an old-established firm about to add to its line an article which, tho identical in its functions and requiring the same market, had heretofore been considered as belonging to a distinct and separate manufacturing business.

One of the first things our superintendent did was to fit up a press with a scraped bolster, after thoroughly going over the whole machine in the same way, and I had the real pleasure of doing a great deal of the work. The shaft and all of its bearings were thoroughly scraped to a fit, as well as all connections, and the parts held to the body by bolts, so that when once it was properly adjusted the necessity for frequent "setting up" was absolutely done away with. I think I am correct in saying that fully six months' constant running did not show any reason for taking up any lost motion, and then only the taking apart thru curiosity to see the surfaces made readjustment necessary. The result of this examination led the superintendent to remark: "I don't believe in letting a machine 'wear itself down.' I prefer to do the wearing myself in an intelligent and accurate way with a scraper." I have since heard the same sentiments expressed by a prominent New England machine builder, who builds in that way to-day, and whose machines bear their own character the world over. He calls it *his* way. It's a good one.

The results with our press were identical with those mentioned in your article. The bolts, when screwed down with the fingers, would yield but little to a 12-inch monkey-wrench. In fact, one knew when they were "down" by that feeling that tells the experienced workman when his micrometer is closed accurately on a parallel piece, and which makes him prefer one without a ratchet attachment, he using the latter "set tight" only as a means of more quickly adjusting to various approximate sizes.

We found that it paid for just such reasons as you state, and for some not specified. Altho intended solely for sub-press work, it was found to pay on the simpler, old style dies, as the cost of maintenance was thereby reduced to a minimum. This was thru our being able to set the press fine enough to barely give us a sample from a piece of tissue paper, and then to run thru heavy brass with excellent results.

Such fine and correct adjustment being possible for such extremes of resistance, it must be apparent that the damage sustained by punch and die coming in contact with one another would be very slight, and that when necessary to re-sharpen, the amount to be ground off and the time required to do it in would be proportionately small.

Of course the machine was strong enough to enable us to leave all tendency to spring out of our calculations. As more dies are probably ruined by improper setting (where the sub-press is not used) than in doing their work, we arranged to have dowels take care of this part of the work, thus also saving much time, especially where spring strippers were used. Our results in this direction were so satisfactory that we made some compound wheel dies which were too large for any sub-press on hand, and we depended on these dowels entirely, without ever getting into any trouble.

To accomplish this, we first made a gray-iron templet with hardened and ground bushings for center and dowel holes respectively. From this we transferred into the bolster and also into the gate of the press, and bringing the two together with the templet between, we secured the bolster to the bed of the press by doweling. A master piece was made to indicate any error in the relative positions of gate and bolster, but I don't remember to have used it in the three years

I was there, as the thoro scraping had allowed no error to wear in and as perfect alinement had been assured at the start. The templet was used afterward for transferring the holes into punch and die blocks, reversing it as upper or lower block was required, in order to secure alinement of centers.

I think your engineer's estimate, "four to five times as long," extremely modest, as dies so cared for will last much more than that number of times as long as when used in a press where it is necessary to set the punch into the die deep enough to compensate for the multiplication of errors due to neglected fitting.

Scraping, of course, will not eliminate the spring in a too weak press. I have since been given the opportunity of so fitting up a press, but declined, after being refused a new one strong enough to do the work properly, on the ground that it had "done our work so far without breaking." I preferred hearing my theory laughed at to being responsible for its failure, which under such conditions would surely have occurred.

All new things have to travel the same old road, but as to what is new or old is often a mere matter of geography. As to scraping, much of its value is lost sight of owing to its initial cost when done by incompetent hands under improper direction. It is generally looked upon as a special branch, and is often so conducted, but it should be a part of every toolmaking mechanic's stock in trade. It is often overdone and as often misapplied. But if a competent mechanic who knows its value as applied to the work in hand knows also how to scrape well, his judgment will enable him to stop long before the average scraper who lacks that knowledge will think his job half done. In other words, if he can know that 50 per cent. less bearing surface than his fine bench block contains will be amply sufficient if evenly distributed, he will take his file to rough down and with the scraping tool make quick work of that bolster. If a strong man, so much the better, for it is not altogether easy work, and scraping does not mean so much what the word implies as it does taking off material instead of scratching and burnishing for mere looks' sake. To those who do not know the difference between the real and its imitation, much of the prejudice against it seems natural, and many of its nicknames, such as "flower work," "fancy jiggering," etc., seem quite appropriate.

H. B. B.

Tool for Spacing and Scribing Circumferential Lines on Copper Rolls.

Fig. 1 shows a wooden roll with a copper tube forced over it. There were to be about 2,000 holes drilled thru the copper to hold wires and form a brush. The roll did not run true, so the spring spacing and scribing tool, Fig. 2, was made. *A* is a piece of ½x1-inch iron bent at right angles. *B* is a brass barrel which holds the scriber *C* and the spring *E*. *I* is a small pin in the stem of the scriber, which slides in a slot in the barrel and prevents the scriber from turning. *D* is a lock nut to hold the barrel in place. *F* is a knob. *G* is a spacing point which can be set to suit the job and is held by the thumbscrew *H*. After the first line is scribed the carriage is moved so that the pointer

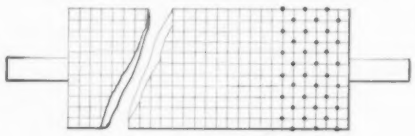
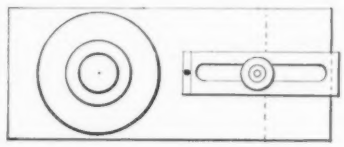


FIG. 1



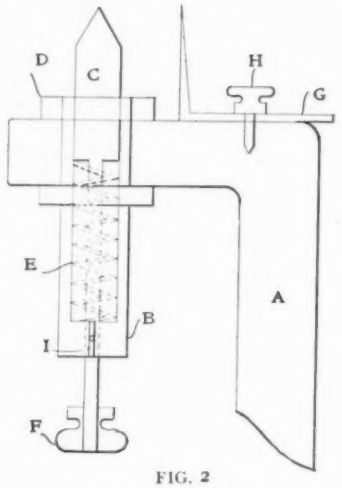


FIG. 2

American Machinist

THE WORK AND THE TOOL.

G is at the line just scribed. The roll was spaced without stopping the lathe. The longitudinal lines were made by running the carriage back and forth by hand after dividing one end of the roll.

P. Rooser.

Another illustration of the many uses to which a telephone may be put comes from Paducah, Kentucky. It had been decided to paint the inside of a large standpipe belonging to the water company. To do this a raft was constructed to float upon the water within the pipe and serve as a platform upon which the painters might work. A telephone was installed within the pipe and connected with the pump room of the plant. When the men had painted as far as they could, they signaled the engineer to raise or lower the level of the water as desired. In this way a great deal of time was saved, as well as the cost of staging which had previously been used.

Dimensions on Drawings.

BY W. S. ROWELL.

Because of the repeated annoyances and some serious mistakes originating in badly dimensioned drawings, I wish to suggest that anything that can be done to standardize such work and bring draftsmen to a realizing sense of the importance of this, to many of them small item, is a step in the right direction. No matter what system of dimensioning could be decided upon, it certainly would be better than no system, and better than scores of systems.

This subject could be treated by me from no other than the shop point of view. There are those that say the painter alone should criticise paintings, the musician music and the mechanic a self-binding harvester; but there are plenty to believe that the final test of any work, whether of art or artisan, is in the *using*, and that if the mechanically perfect harvesting machine fails in the field and the correctly (?) dimensioned drawing leads to a monstrous number of mistakes in the shop, *both* have failed. No one in his senses will contend that system, even throughout one drawing office, is to be *easily* obtained; still, any and all movement toward that end is right. Many have written on methods, but no one, so far as has come to my knowledge, has urged anything like a universal system throughout one country. My idea is that much could be done to systematize such things throughout the English-speaking world. We *do* keep up similarity of speech and spelling and have a tendency to get nearer together in such matters, despite many divergencies that may be pointed out to-day. As the matter appears to me, no number of vagaries in spelling the same word could ever be so harmful as a variety of ways of dimensioning drawings.

The move toward standardizing abbreviations in technical publications as recently recorded in the American Machinist is a much needed move. Let us all help it along in any way we can. A very false view of this matter of abbreviations prevails. Persons that would not agree to any departure from orthodox spelling believe it is anyone's—especially their own—privilege to invent and use all sorts of fantastic abbreviations. A moment's reflection will show the contrary. Spelling, writing, printing, and even spoken words are but signs used to represent something else, and derive their *whole* value from their being generally understood by a large number of persons to stand for the same thing, yesterday, to-day, and to-morrow. This being true, it is reasonable and right that the same sign be kept for the same thing. All of those who depart from previously decided upon signs are to a greater or less extent sinners against the convention. It is easy to see that sqr *would* spell rat, just as well as gneiss spells *nis*, if it were generally understood

to spell it; and the only wrong in spelling it thus is that it would *not* be generally understood. Anyone who introduces his own or little used abbreviations into matter intended for those not "in the know" is as guilty as tho he introduced a private cipher in the letter intended for the public. It should be clear to all that as abbreviations are but signs one remove farther from the reality for which they stand, their integrity should be, for that reason, more carefully guarded than that of words.

Few probably will deny that the Arabic numerals are signs only, and derive *all* their value from always standing for the same thing. Fortunately, they have been so simplified—abbreviated—that really new forms—further abbreviations—are scarcely possible; that is, while the word *eight* can be spelled many ways and not wholly depart from some kind of usage, the Arabic character that stands for the same cannot be so manipulated and be thought of as still conveying the same meaning. The most that the heretics can do is to make these numerals so negligently as to make it difficult to identify them. There being but ten, one can always be sure of hitting what is meant in ten guesses, tho he cannot always know when he has hit it. In these Arabic characters we have a valuable heritage, which is more than can be said for our written and printed characters. The Arabic numerals used with either of the forms of fractional notation leave little to be desired. It is only their misuse that leads to error.

One conspicuous fault in the Arabic characters as used in stamping work and many times in dimensioning drawings is the use of one character for both nine and six. In my own case (and I understand that some large manufacturers do the same) where work is at all important a special nine is made and used. It is the same nine as is used in writing—*i. e.*, with a straight stem—and wholly does away with the liability to error that attends the use of one character for both purposes.

Another fault that is almost universal in England is the use of a three that looks like a druggist's drachm mark and is often mistaken for a five. In fact, the best of eyes are tried by the smaller sizes if stamped at all deep. This same five-like three occurs on many English drawings and often leads to error.

A repetition here of some of the monstrous things done in dimensioning drawings that come to the notice of all who have them to read would be out of place and useless. What is wanted is uniformity; and, if possible, simplicity.

If the decimal system of fractional notation is chosen, it is always best to decide how many decimal places are to be used in cases of ordinary refinement and use that number in *all* cases. Suppose, for instance, that the inch is the unit of measurement (and it usually is in English-speaking countries, and not the foot or yard), three decimal places will usually be found sufficient in engineering work. I know the temptation to tack on the fourth one occasionally is great; also that following 1 with two ciphers seems extravagant; but when it is so easy to, in this way, reduce all your fractions to a common denominator, just do it, and not commit so monstrous a blunder as measuring quantities of the same material in different measures. Perhaps others will recall some statements in the AMERICAN MACHINIST regarding amounts of metal removed by the same tool or form of tool at different speeds and feeds; these quantities being stated in pounds, ounces and eighths, tenths, twelfths, fifteenths, and seventeenths of ounces, if I remember rightly. It is no uncommon thing to see six different units and fractions of units used inside of six inches in length on the same drawing dimensioning different parts of the same piece. Another very good reason for using three places of decimals is that most of our refined measuring instruments for measuring length are graduated to the third place.

The decimal form of writing fractions includes some inconvenient limitations, especially when used in connection with binary subdivisions; but as it lends itself so readily to the common denominator idea and consequently to all summations and computations it is probably preferable to the vulgar, or common form. The vulgar fraction form possesses the great advantage of being always known as a fraction, *if* carefully written; and the same may be said of the decimal form if three places are always used. It is agreed by all who have given the matter any thought that the decimal point should always be above the line and as distinct as possible. The indistinct character of the point is one of the objections to the decimal form.

I am usually able to see *some* advantage in any of the many peculiar ways of writing dimensions and would be pleased to help ever so slightly in choosing the best available form and bringing that form into common use. One pernicious custom for which there seems the least possible defense is the use of plus and minus signs in dimensioning drawings. Tho such things are found on well-finished drawings as $\frac{3}{16} - \frac{1}{32}$ few will be found to defend them. Nevertheless some otherwise beautiful drawings are disfigured and rendered positively dangerous by such things as 3⅜″ — .005 and 3⅜″ + .005, and with the minus and plus quantities often so far to the right as to be not readily understood by the workmen as belonging to the mixed numbers that precede them. Leading men of large establishments are found to defend such things. Perhaps the uninitiated are not to judge; but the chances are that far more than 90 per cent. of shopmen would say that 3.370″ and 3.380″ is a far safer way to write them, tho not every workman may think he understands at first glance the dimensions intended. In other words, if a man cannot read 3.370″ because it includes a decimally written fraction, how is he to ever understand 3⅜″ — .005? I have been told that he *will* understand the 3⅜″ and will inquire of his foreman the meaning of — .005. That has often been done to my knowledge, and in some very provoking cases the inquiry was made after the hole was bored 3⅜″ and the piece hopelessly spoiled. Why a decimally written quantity set so far away as to be a matter of uncertainty where it belongs, or even set immediately to the right of a plus or minus sign that follows a whole or mixed number is innocent and harmless, and one included in the dimension in the most compact form possible is harmful, is hard to see.

One thing that could be done very easily and that would eliminate one fruitful source of error, is to keep the foot off all drawings. No one will misunderstand me, the foot of twelve inches is meant; and when it *is* used indicate it by something less likely to lead to error than the single tick and short dash. Probably it would do little or no harm above ten feet or twelve feet, but no one can deny that 3′ 3″ is likely to be read thirty-three inches. Of course I know that many establishments do guard against such errors in different ways; but the attempt to do so by saying all quantities over twelve inches must be written in feet or feet and inches has never to my knowledge resulted satisfactorily. Never has any large set of drawings been seen by me where the rule was strictly adhered to, and if it were, there would always be men familiar with other usage that would make such mistakes as reading 2′ 2″ as twenty-two inches, or 1′ 1″ as eleven inches. I am told that if a man makes such mistakes he must be put where he will do less harm; but it is rarely the same man twice in a year, and I have known one case where the leading experts of a large establishment were called in consultation and all read one of those difficult plus and minus dimensions wrong—read it wrong when they were on their guard and had a *clean* print to read it from.

The Biggest Ferryboat.

At page 1602, Vol. 27, we spoke of the enormous ferryboats plying between Oakland and San Francisco, the largest being 284 feet long, with seats for 1,700 persons. A correspondent kindly calls our attention to the fact that in the same waters there is another boat for passenger car transfer, which is much larger. This is the "Solano," which plies between Port Costa and Benicia. She is 425 feet long over all and 116 feet wide outside the guards. There are four car tracks. The nominal horsepower is 2,000, the paddle wheels on the opposite sides being driven by independent engines, so that if necessary they can be driven in directions opposite to each other. The boat has been drydocked only once since she was launched in 1879.

Foreign Markets for American Machinery.

There are many openings in Belgium for American tools and machinery. For instance, there are now about 800 steam engines running in connection with the seventy or more mines in Belgium. Many of these are of old types, and there should be an opening for more economical engines. Any United States consul should be in a position to put American manufacturers in touch with the mining and other companies likely to become purchasers. There is also a decided demand for machine tools and kindred appliances in connection with the gunsmith's trade. Pneumatic tools are finding favor in Belgium. Makers of quite up-to-date mining tools and plant would find it worth their while to look after the trade. The equipment of the mines in the Liége district, and generally over the whole of Belgium, is very backward, many modern implements for the saving of labor which are in general use in other countries being as yet quite unknown. The vast Limbourg coal fields are shortly to be opened up and will doubtless be installed with the most recent machinery for extraction, pumping and ventilation, and there will of necessity be a large demand for shaft-sinking and other appliances.

Belgium is a country which offers great advantages to foreign commercial enterprise. The duties imposed on manufactured articles are in no case prohibitive, while they are sometimes nil. No prejudice whatever exists as regards the nationality of the competitor, provided that he complies with the rules and regulations laid down. In the consideration of tenders, generally speaking, not only the lowness of the price, but quality of material and workmanship are all weighed together in the balance regardless of nationality. The principal condition in securing contracts for the Belgian Government and other official bodies is the furnishing of guarantees for their fulfillment; as bids, tho the offers appear to be high, are far more likely to be accepted when accompanied by satisfactory guarantees than those which would at first sight appear to be more advantageous, but are not so certain to be reliably carried out.

Russian Poland offers a splendid market at this time for electrical fittings and apparatus of all kinds. The trade is one worth considering. There is an excellent demand for dynamos, motors, accumulators, electric light fittings of all sorts, arc lamps, etc. Especially at Warsaw, where this trade has up to the present been stagnant, there is now prospect of a good business. Only just recently important additions have been made to the electric depot, and this form of lighting for private houses as well as for shops, etc., is becoming every day more popular.

Makers of small pumping plants have a capital chance of obtaining orders in the Trans-Caucasus. A few years ago a smart native erected a small pumping station in one of the villages of the district of Salin and concluded an agreement with the inhabitants of the locality to furnish them with water for irrigating their fields during a period of twelve years, in return for which he was to get one-third of their crops annually. This agreement has had such a success and he has earned so much money that he has been able to extend his enterprise and to erect several similar pumping stations in the country districts round about, and continues to make a large profit out of the undertaking. There is every reason to believe that on several other tracts of land, which at certain times of the year remain arid, the population of the locality in question would be prepared to enter into an arrangement somewhat similar to that referred to above with any persons desirous of introducing a systematic application of irrigation in the district. So anxious are many of the peasantry to further the scheme that several of them would even be prepared to give the land required for the purpose of building the pumping stations and other necessary installations.

Pump manufacturers have also a likely market in Mexico. The development of the mining industry in that country has created a demand for centrifugal pumps of a much higher pressure than those up to now employed, of a larger capacity than usual, and able to raise water from a depth of 200 to 300 yards. The first of these pumps introduced was of Swiss origin and was supplied from that Republic; but the Swiss makers sold their patents to the United States manufacturers, who now supply all the larger pumps used in the chief Mexican mines. There is an ever-increasing demand for steel tubes for draining purposes. The smaller sizes are supplied from Germany, but the American Steel Trust supplies those of a larger diameter. There is bound to be a very large market for heavy tubes before long, as many of the cities in Mexico are about to start drainage works. Two years ago Messrs. Letellier and Vezin, of Paris, obtained the contract for draining Mexico City, and now such towns as Monterey, Morelia, Puebla, Orizaba, etc., are to be modernized in this respect.

American manufacturers of sawmill plant and machinery might find it profitable to inquire at Foochow, China, respecting the demand for such plants, as I believe there is a good chance of business being secured. Two foreign-owned sawmills—one British and the other German—have both been provided with up-to-date machinery. They have been in operation for several years and are doing well, their business and profits having risen enormously during the last five years. Their chief business is the manufacture of wood for tea chests, kerosene oil cases, soap boxes, etc.

Several purchases of gasoline engines and launches have recently been made by New South Wales, Queensland and New Zealand, and the business has been placed with United States firms. There is every chance of further orders being given in the near future, and it would be well for United Stats engineering houses with connections in the colonies named to communicate with them on the subject.

The South African market is steadily, if slowly, improving. What is now badly wanted by the South African farmers is a movable engine of moderate cost and bulk which could be put to work of various kinds on a farm. It should be available for irrigating purposes, for chaff cutting, cream separating, mealie shelling, etc. It must be portable and light.

London. C.

Perpetual Motion in Worcester.

In the *Worcester* (Mass.) *Daily Telegram* we find an account of an alleged perpetual motion which is described as follows:

Mr. Blake's device is a hoop of brass, set at regular intervals with cylinders, which, joining the axle, form eight spokes, presenting right angles after leaving the hub. The wheel is set three degrees off center.

The cylinders are at 90 degrees, while from the axle to the extreme of the right angle is 93 degrees. The cylinders are provided with tightly fitting glass tubes, each containing half an ounce of mercury in the part from the axle to the rim, and a quarter ounce in the angle tube.

"The wheel being set three degrees off center," Mr. Blake said, explaining the idea, "is sufficient to start it in motion, while on four of the spokes, with the weight and momentum of the mercury, we gain three degrees, losing the same number on the remaining four spokes, thus giving us six degrees, at once overcoming what is known as the dead center.

"The friction of the two pivots, made of hardened and pointed steel running in black lead, is not of sufficient importance to mention. The only drawback is that the wheel cannot be run at higher speed than perhaps from 80 to 100 revolutions a minute, neither can it be put to practical uses as a factor in the field of applied mechanics."

This will readily be seen to lack something in the way of lucidity. We addressed a letter of inquiry to the inventor and have received a reply from him, from which reply we gather the impression that he does not wish to impart information to the mechanical public regarding his invention, and so we shall have to get along as best we may without it. The inventor intends perhaps to let the wheel run forever to prove that it will do so before he reveals the secret of its construction.

The internal combustion engine is not such a novelty after all; one was in operation in Cambridge, England, in 1820.

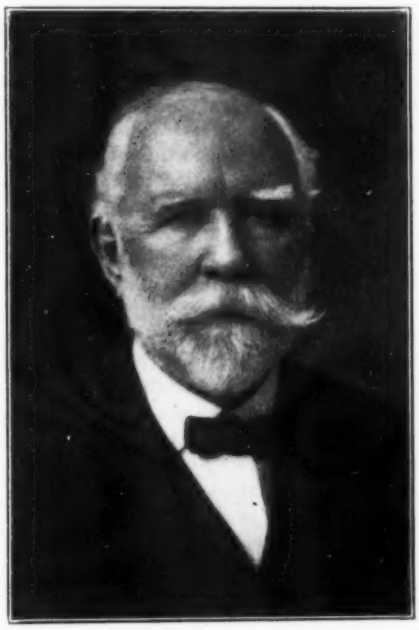
William Sellers.

William Sellers died at the University Hospital, Philadelphia, January 24. He was taken to the hospital three weeks before, suffering from acute kidney trouble, but death came quite unexpectedly.

Mr. Sellers' first ancestor in this country was Samuel Sellers, who came from Belpre, Derbyshire, England, in 1682 and whose marriage to Anna Gibbons in 1684 is the first recorded in the minutes of the Darby Meeting of Friends. Samuel Sellers took up a tract of land in Upper Darby under Penn's patent. This property was in the possession of his descendants to the present generation, and a portion of it, with the house in which William Sellers was born, still belongs to his estate. He was the oldest son of John Sellers and Elizabeth Poole, of Wilmington, Del., a sister of J. Morton Poole. Her grandfather, William Poole, it is said, was sent to this country by the Royal Geographical Society of England to observe a transit of Venus.

William Sellers was born September 19, 1824. He was educated at a private school built and maintained by his relatives for the education of their children. At the age of fourteen he was apprenticed to his uncle, J. Morton Poole, and served nearly seven years as a machinist and in mechanical engineering work. In 1845, after coming of age, he went to Providence and took charge of the large shops of Fairbanks, Bancroft & Co., builders of steam engines and mill gearing. Two years later he returned to Philadelphia and began manufacturing on his own account. In less than a year he admitted Mr. Bancroft, one of his former partners, under the firm name of Bancroft & Sellers. This firm existed until the death of Mr. Bancroft in 1855. Prior to that time John Sellers, Jr., had been admitted to membership and the firm name became William Sellers & Co. In 1886 the corporation of William Sellers & Co., Incorporated, was established, with Mr. Sellers as president and engineer. In 1873 Mr. Sellers became president of the Midvale Steel Company, at Nicetown, which company he subsequently reorganized. Five years before his election to the presidency of the Midvale he established the Edge Moor Iron Company, for the manufacture of iron and steel structural material. The company made all the iron for the Centennial Exhibition of 1876 and for the Brooklyn Bridge. In 1864 Mr. Sellers was elected president of the Franklin Institute, and in the same year his paper was presented which led eventually to the establishment of the only known standard of screw threads in this country, variously known as the Sellers, the Franklin Institute, and the U. S. Standard. The angle and the truncated form of thread proposed were adopted by the International Congress for L'Unification des Filetages et des Jauges, held at Zurich in October, 1900. When Mr. Sellers became president of the Franklin Institute it was in a critical financial condition. By his energy and wisdom it was reconstructed and placed upon a sound basis.

Of the honorable and successful career of Wm. Sellers & Co. in recent years it is unnecessary to speak. At the Exposition Universelle at Paris in 1867 a gold medal was awarded. At the Centennial Exhibition in 1876, in Philadelphia, the judges reported, "This collection of machine tools was without a parallel in the history of exhibitions, either for extent, or money value, or for originality and mechanical perfection," and at the Weltausstellung in Vienna, in 1873, the Grand Diploma of Honor and five gold medals were conferred upon the firm. At the Paris Exposition in 1889 the highest award —the Grand Prix—was given to Wm. Sellers & Co., Incorporated, together with several medals, and at the close of the exposition the names of three collaborateurs were requested, to whom, as individuals, diplomas were sent, and to William Sellers, in addition, the honor was conferred of Chevalier de la Legion d'honneur.



WILLIAM SELLERS.

In 1868 Mr. Sellers was appointed a member of the first Fairmount Park commission. In 1873 the Centennial Board of Finance was created by Act of Congress, for the business management of the Centennial Exhibition of 1876 and Mr. Sellers was elected one of the two vice-presidents, and much of the success of the exposition was due to his efforts. The influence and personality of Mr. Sellers extended in various other directions. He was for several years a director of the Reading Railway and of the Philadelphia, Wilmington & Baltimore Railroad. In 1868 he was elected a trustee of the University of Pennsylvania. Five years later he was elected a member of the National Academy of Sciences, and in the following year was made corresponding member of the Paris Société d'Encouragement pour l'Industrie Nationale.

Mr. Sellers was thus supereminent not only as a mechanical engineer, but in the large affairs of business. Under his guidance the establishment of Wm. Sellers & Co. has exerted a very profound and far-reaching influence upon the art and science of machine-tool construction, and his fame as a tool builder extends over the civilized world, wherever machine tools are known and appreciated. A few years ago Mr. Sellers was regularly nominated as president of the American Society of Mechanical Engineers, of which he was a charter and life member. Competition for the place (not opposition to him) arose and preferring not to enter into the competition he insisted upon the withdrawal of his name, which was done.

Calendars.

Our crop of calendars for the year 1905 has included a wide variety of designs with some unusually attractive ones, and our thanks are hereby extended to all who kindly remembered us. Our list includes the following:

American Steam Pump Company, Battle Creek, Mich.

Cleveland Pneumatic Tool Company, Cleveland, Ohio.

Crocker-Wheeler Company, Ampere, N. J.

Diamond Drill & Machine Company, Birdsboro, Pa.

Diamond Saw & Stamping Works, Buffalo, N. Y.

A. W. Harris Oil Company, Waterbury, Conn.

Hoefer Manufacturing Company, Freeport, Ill.

Kutztown Foundry & Machine Company, Kutztown, Pa.

London Machine Tool Company, London, Canada.

The Lunkenheimer Company, Cincinnati, Ohio.

Manville Bros. Company, Waterbury, Conn.

F. E. Myers & Bro., Ashland, Ohio.

National Electric Company, Milwaukee, Wis.

Wm. J. Oliver Manufacturing Company, Knoxville, Tenn.

Pacific Tool & Supply Company, San Francisco.

Triumph Electric Company, Cincinnati.

H. B. Underwood & Co., Philadelphia.

Vulcan Iron Works, Toledo, Ohio.

The system of paying employees by bank checks instead of in cash has been introduced in a number of the mills in the Pittsburg district. It is announced that hereafter wages will be paid by check at the mills of the American Sheet & Tin Plate Company, and preparations are being made at Newcastle and Sharon, Pa., to pay the employees in the same way.

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The Meaning of Terms.

An interesting example of differences resulting from various standpoints was to be observed during a recent gathering of engineers, in which two men engaged in the same line of manufacture were discussing results obtained in processes of hardening; especially with respect to the distortion caused by it. One of these manufacturers claimed that he had entirely overcome the difficulties resulting from this and that the articles turned out by his firm were accurate after being hardened. The other, an equally large and experienced manufacturer, acknowledged that he had not been able to attain accuracy, nor to get as near accuracy as seemed desirable, but that, on the contrary, there was a considerable distortion in the hardening, and one which seemed to be uncertain both in its direction and amount. His inquiries as to how the other man obtained the accuracy claimed were met by simple assertions that the accuracy was obtained and that it was for those who wished to know to find out how it was obtained. Then an effort was made to get at what was meant by accuracy, and repeated questions in various forms were propounded designed to bring out the limits of variation. All to no purpose. It was simply insisted upon that the work was accurate, but no figures were forthcoming. Now it happens that in this case the man acknowledging that he could not secure accuracy was certainly turning out much the more accurate work. It simply meant that his standard of accuracy was much higher than that of the other man. He possessed means of knowing precisely how near to exactness his work was coming out and was able to state figures for the variation. The claimer of perfection simply possessed no means of knowing exactly what the variation was, but was pursuing the rough and ready methods of the old times; was finding the work satisfactory to himself, judged by his own standard, and was therefore claiming that it was absolutely accurate, probably without the shadow of a foundation for such an assertion except his own complete lack of appreciation of what is really meant by accuracy, or precision.

Something of the same difficulty continually presents itself with regard to contributions that are sent to us and that appear in our pages. Different shops and different individuals have entirely different conceptions as to what constitutes a satisfactory job of work—what is a good finish, a good design, a good fit, a stiff or powerful tool, a large bearing, etc.—and many of the differences of opinion that arise among our contributors are based upon some such differing ideas and conceptions of the actual meaning of the same terms. It is vitally necessary, in coming to an understanding among ourselves that the words we use shall have precisely the same meanings to all of us, and the fact that they do not leads to a good deal of useless discussion in other fields of human thought as well as in the field of mechanics. Where there is danger of such misunderstanding it is better to define one's terms or to state plainly just what their meaning is in the mind of the one who is to use them, and then carefully avoid using them in any other sense or with any other shade of meaning.

Friction.

"Some of the text-books have it that friction is determined by pressure or weight, and not by the area of contact of the surfaces. The truth in practise is, that lessening the area lessens the friction; it also lessens the chances of rough surfaces."

We know that in the exigencies of make-up time such "fillers" as the above, which we take from a contemporary, cannot always be prepared with the utmost care and that they sometimes get in without such strict inspection as they ought to have. But the text-books are right and all that follows the statement of what they have in them is wrong. Lessening the area does not lessen the friction except in very rare cases and under peculiar circumstances; nor does it lessen the chances of rough surfaces, but nearly always increases the chances of *roughened* surfaces. The error in this case may have arisen from observation of journals whose diameter has been reduced, thereby reducing the moment of frictional resistance. But this is very different from reducing the friction. It remains true in practise as well as in the text-books, that, so long as the coefficient of friction remains unaltered, friction is independent of the area of the surfaces in contact, and Morin's law holds good. At excessively high speeds or very heavy loading per unit of area the coefficient of friction may change, but that does not alter the law. Chordal's familiar tale of the brick resting upon three different areas, *i. e.*, so that, first its flat side, then its edge and then its end surface rests upon a board and being pulled along by the same force in each instance, still illustrates the law of friction. That law has not been upset and it takes much more than a paragraph to tell about the seeming exceptions to it and to explain them.

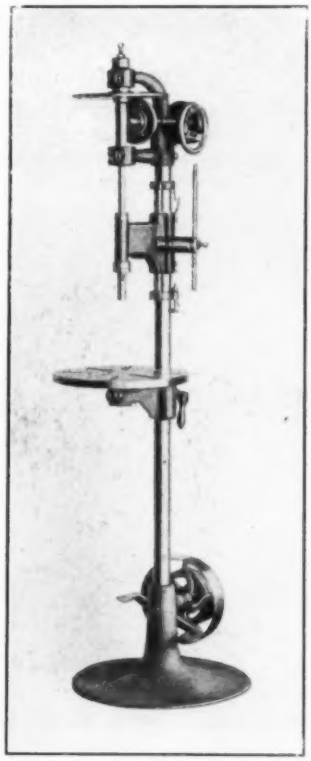
It is announced that *The Times*, of London, will publish an engineering supplement to its daily edition, and has the endorsement of it by a number of very prominent engineers and scientists. "Applications for advertising space to include the first issue are considered but not invited."

The Isthmian Canal Commission is advertising for proposals for stone crushers. Specifications and all particulars may be obtained by addressing the office of the Commission, Washington, D. C. The bids will be opened February 15.

New Tools and Machine Shop Appliances.

FRICTION DRIVEN DRILL.

The illustration shows a friction driven drill built by Francis Reed Company, 43 Hammond street, Worcester, Mass. This drill belts direct to the line shaft, no countershaft being necessary. The friction plate is on top of the driving pulley. With this arrangement dirt is less likely to get in between the faces, and the weight of the friction plate and shaft is always on the driving pulley, thus decreasing the amount of forced contact necessary. A screw is provided on top of the friction plate shaft, for forced contact. This screw rests on a ball thrust bearing with a spring contact on the plate shaft which runs in ball bearings. By turning the hand-wheel geared to the driving pulley shaft, a 3 to 1 speed variation may be obtained. The head slides on the standard and gives a travel of 10 inches to the spindle, which is provided with a ball thrust. Stops are provided to gage the travel of the head which is counterbalanced by means of a spring. The foot lever on the right of the base is to start, and that on the left to stop the machine by means of a friction clutch. The principal dimensions are: Size of base, 20 inches; steel column, 2



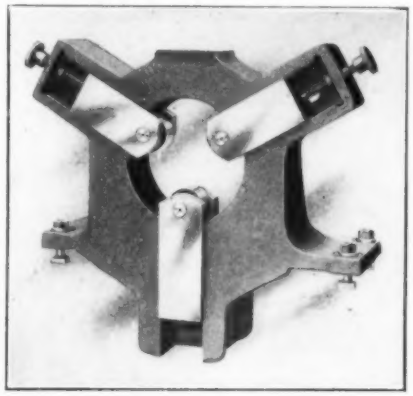
FRICTION DRIVEN DRILL.

inches; table, 15 inches; vertical adjustment of table, 27 inches; greatest distance from table to spindle, 32 inches; total hight, 72 inches; weight, 210 pounds.

A test was made by the makers with this drill, the result of which was a 9-16 inch hole was drilled to a depth of 4 inches in solid gray iron; time, 1½ minutes.

HIGH-SPEED FOLLOWER REST.

The illustration shows a new follower rest brought out by the Lodge & Shipley Machine Tool Company, Cincinnati, Ohio, for use in connection with its high-speed lathes. The rollers which bear upon the work are of hardened tool steel, and are



HIGH-SPEED FOLLOWER REST.

mounted upon hardened and ground steel shafts, upon which they are fixed by screws thru the rollers. Oil holes are provided for the journals of the rollers. The adjustment is by means of screws with nurled heads, so that they cannot be set down too tightly. At extra charge an angle bracket is supplied which is attached to the pad at the top of the follower rest, reaches over the cross-slide and is secured to the wings at the opposite end of the carriage.

IMPROVED DROP HAMMER.

The improvements in the drop hammer here described consist in dispensing with the hold-up latches and produce a hammer which is free from noise in all the working parts, under perfect control, and with a lifter which can be placed over any drop hammer.

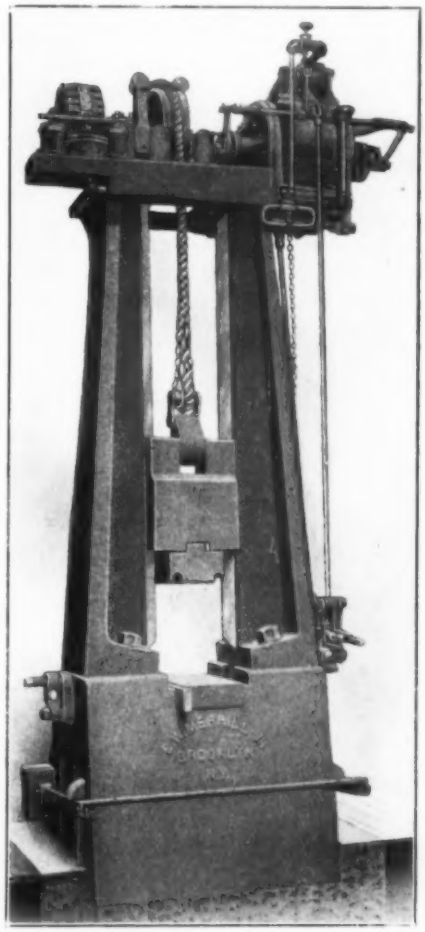
The hold-up brake which here displaces the usual latch is fastened to the main lifting shaft and works in conjunction with the main valve which operates the lifter. The instant the partly rotating lifting shaft stops, the brake is automatically applied and securely holds the shaft in any position at which it is set to stop, thus holding the hammer suspended in any desired position. Connected to the treadle by means of a light chain or rod is a small controlling valve, used to release the hold-up brake. By keeping the foot depressed upon the treadle the hammer will deliver repeated blows until the foot is removed. A single blow can also be given. If the treadle is depressed but slightly, a light blow will be given. If for any reason the supply of steam or compressed air should be turned off, the hammer cannot fall, even should the treadle be depressed. This is owing to the fact that it requires the steam or air pressure to operate the brake-controlling valve before the hammer can fall.

These lifters can be placed over any style drop hammer, because the entire operating mechanism is self-contained upon the one bed plate.

They can be constructed to raise the hammer as high as eight feet, at the same time are adjustable to any lesser hight of fall, and a drop as low as six inches may be obtained. Changing to trip automatically at any desired hight between the lowest and highest range of fall requires only a few turns on a small turnbuckle, which process consumes but the fraction of a minute. It is possible to make the adjustment in hight of fall while the hammer is in operation.

The rapidity with which blows may be delivered depends upon the steam or air pressure. Under ordinary conditions they will be delivered at the rate of 100 blows per minute with a 1-foot fall, 75 blows with a 2-foot fall, 60 blows with a 3-foot fall, and greater falls at proportionately less speed.

When setting dies the hammer can be



IMPROVED DROP HAMMER.

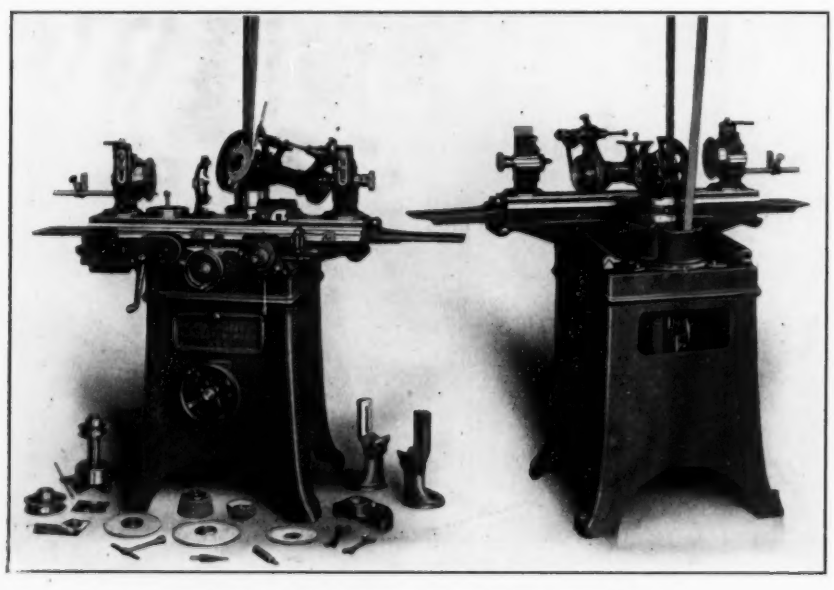
lowered and held permanently suspended in any desired position, or gently lowered until the faces of the dies meet. When the hammer is held stationary in a raised position, steam is not consumed, as the tension upon the brake which holds the lifting shaft is applied by two powerful compression springs. The hammer can be worked

without much effort on the part of the operator, because it requires but a slight pressure upon the treadle to open the brake valve. The motive power, being steam or compressed air, makes it possible to place the machine in any convenient location where a supply pipe can be run. By this method of lift it is possible to successfully raise very heavy hammers. Forgings weighing 240 pounds each have been formed from the solid by hammers raised in this manner. The hammer gives a free and heavy blow, as there is nothing to retard the fall. The catching of the hammer on the rebound is instantaneous, which eliminates all drag and double blow after the dies strike.

These machines are made by E. W. Merrill, Jr., Brooklyn, N. Y.

TOOLROOM GRINDER.

The illustrations show improvements that have lately been made on the toolroom grinders manufactured by the Walker Grinder Company, Worcester, Mass. We described this grinder at page 1048, Vol. 27, as it was before these improvements were made. The changes consist of an improved design of column for the grinder, but more particularly of an enlarged and improved wheel post and housing, whereby one side of the belt passes down thru the post, which is slotted at the bottom to provide an opening for the stationary idler around which the belt passes on its return. This idler is shown in the rear view thru an opening in the column, and altho it is normally stationary it can be adjusted to take up the stretch of the belt. All the other features of the old arrangement of belting are retained, and it is more thoroughly protected from the grit. An increased diameter of post is obtained as well as an increased vertical adjustment, and the spindle will still rise and fall and swivel horizontally and vertically, all without affecting the tension or the running of the belt. An improved automatic feed device has been provided, and a complete set of attachments is furnished. In the front view of the machine the spindle is shown adjusted in an oblique direction, both horizontally and vertically.



FRONT AND REAR VIEWS OF TOOLROOM GRINDER.

10-INCH WOOD-TURNING LATHE.

The accompanying cut shows a 10-inch wood-turning lathe of new design which has just been placed on the market. This lathe is suited for use in manual training schools, as it contains many features for such work and wood turners in general. The rated swing of the lathe is 10 inches, but it has an actual swing of 11 inches over ways and 7 inches over the hand rest. The headstock has a hollow spindle (with 17-32 inch hole) made from a crucible steel forging and runs in phosphor bronze bearings which are dustproof and self-oiling. The cone pulley has four steps and is turned inside as well as outside. The tailstock is the curved or cut-under pattern, locked to the bed by a lever which is attached and always in place. The hand rest has long and short T-rests. The rest socket and saddle are locked to the bed by a cam-locking device and the T-rest is held in the socket by a friction clamp. Both are operated by levers attached and always in place. The bed at present is made in two lengths, 4 and 5 feet. The front way is flat and the back way is V-shaped. A shelf is secured to the back of the bed for the reception of tools, etc. The countershaft has self-oiling and self-alining bearings, four-step cone and tight and loose pulleys. The loose pulley has a self-closing oil cup. Face-plate, screw chuck, cup and spur centers are furnished with each lathe, and when desired a slide-rest for metal turning will be furnished at an additional price. This lathe is manufactured by the Seneca Falls Manufacturing Company, 687 Water street, Seneca Falls, N. Y.

10-INCH WOOD-TURNING LATHE.

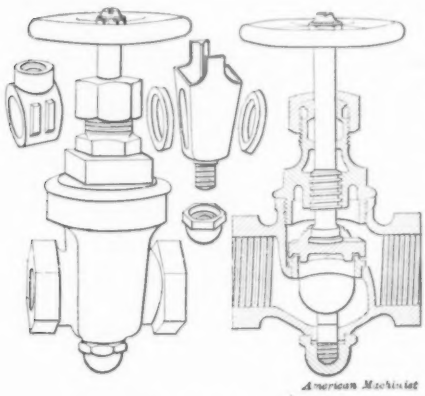
THE MILWAUKEE WET TOOL GRINDER.

The half-tone shows a substantial, simple and effective machine for general tool grinding. The normal size of the wheel used is 24x2 inches. The water is delivered to the wheel by means of an air jet. The blower, situated at the back of the machine, is driven by the tight belt as shown, the tightener being operated by the treadle, which thus determines the force of the blast and the amount of water delivered. The air passes down thru the pipe at the side and enters the bottom of the water tank, and then turns up in the water and blows the clean water up against the lower part of the wheel, by which it is carried around to the tool which is being ground. The water is caught in the bowl and returns at once to the tank. The driving pulley, which has two steps, is on the other side of the machine. The running parts are all balanced and the machine runs smoothly. The machine is about as simple as can be made, with nothing requiring adjustment except the rest to follow up the wear of the wheel. The net weight of the machine is 800 pounds. Built by Lutter & Gies, Milwaukee, Wis.

THE MILWAUKEE WET TOOL GRINDER.

RENEWABLE VALVES AND VALVE SEATS.

It would seem to be simply a suggestion of common sense that in globe valves and the numerous types of valves akin to them the parts which are subject to wear or disablement should be renewable independently of the valve bodies or permanent parts which are little subject to impairment or deterioration. The cut will call attention to the essential features of a new

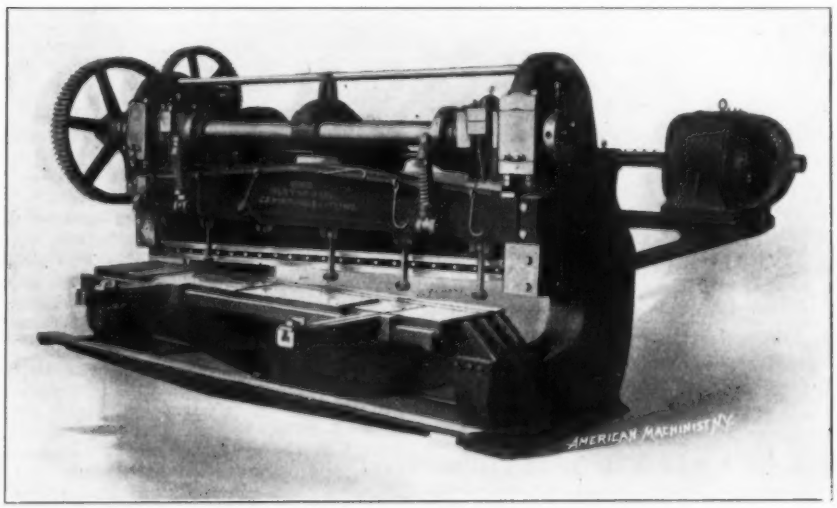


RENEWABLE VALVES AND SEATS.

line of valves made by the Crane Company, Chicago. The separate valves and seats will be noticed, and the way in which they may be removed and repaired or replaced by new pieces requires no explanation. This system can evidently claim first of all the presumption, which is also the fact, that repairs and renewals are rendered less frequent, because special and better material can be used for the valves and seats and other responsible parts. In the globe valve at the right in the cut, by unscrewing the nut on the bottom of the valve and removing the cap on top all parts are perfectly accessible. In putting the valve together the seat is replaced and the nut is screwed on at the bottom, thus holding the seat firmly in place. The straightway valves, shown in detail at the left, are made with copper seats and a hard metal wedge.

MOTOR-DRIVEN GATE SHEAR.

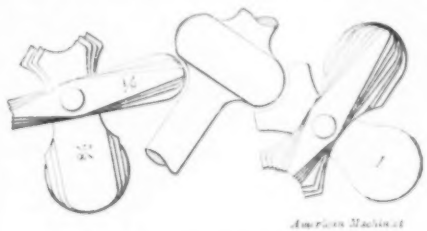
The half-tone shows a new shear built by Bertsch & Co., Cambridge City, Ind., and exhibited at the St. Louis Exposition. This shear has been designed especially for rolling-mill service in which such tools are run continuously and pretty well up to full capacity. It is requisite for it to be quick operating and to shear ¼-inch and lighter sheets and packs 10 feet long. It of course is therefore suitable for any large sheet-iron works. The most prominently noticeable feature is the hold-down, actuated by cams on the driving shaft and so designed that it is self-adjusting for any thickness of metal. The sheet is clamped not by the usual solid bar but by legs or gags which permit a clear view of the shearing operation and which can individually be swung up out of the way if so required, one of them being shown hooked up in the half-tone. Swinging up all the gags instantly converts the machine into a plain shear. The machine has also a special center bearing consisting of an adjustable wedge fitted between a bearing on the rear of the crosshead and another bearing on the heavy cross-tie casting, thus increasing the rigidity of the machine. It will be understood that this is a large machine of its class and it is heavy and liberally proportioned throughout, with strong gears, wide bearings, hardened steel pins and a triple-geared forged steel crankshaft. It has a four-jaw clutch, steel faced, and a tool steel switch ring acting against a steel plunger with a hardened steel roller. The crosshead bearings have adjustable brass gibs. The bronze crankshaft bearings are set in split boxes easily adjustable or removable. The shear is shown here with an independent motor drive, but is also built for belt drive. Brackets, gages and other appurtenances are provided.



MOTOR-DRIVEN GATE SHEAR.

CONCAVE AND CONVEX GAGES.

The cut shows completely a new handy tool and the method of its application. The various blades pivoted on and secured by the central rivet have at one end of each a convex circular outline and at the other end a concave curve of the same radius, the diameter represented being stamped upon each blade. In turning or otherwise shaping any detail of a piece of work to a required circular shape the gage for that circle is swung out from the others and can be applied to the work, as shown. The gages are also handy for



CONCAVE AND CONVEX GAGES.

grinding tools. They are at present made in sets ranging from ⅛ to 1 inch by F. G. Marbach, Medina, Ohio.

New Publications.

"The Progress in Warship Engineering—1903-4." By Charles D. G. Sells. 21 7½x12-inch pages with 10 illustrations. Sampson, Low, Marston & Co., London; Munn & Co., New York.

This pamphlet, which is a reprint from "All the World's Fighting Ships," is a very comprehensive review of recent progress in naval engineering. The leading subjects discussed are the steam turbine, screw propellers, air pumps and condensers, boilers, forced draft, firing signallers, liquid fuel, electrically driven auxiliary machinery and water-tight doors.

"Mechanical Drawing—Part II." By F. E. Giesecke. 64 6½x9½-inch pages with 25 full-page plates. Eugene Dietzgen Company, New York, Chicago, San Francisco and New Orleans. Price $1.

A notice of the first part of this book was published at page 1613, Vol. 26. The pesent part relates to descriptive geometry, shades and shadows and perspective, and the student of it is supposed to be acquainted with the contents of its predecessor.

"A Text Book on Steam and Steam Engines, Including Turbines and Boilers." Fourteenth edition. By Andrew Jamieson. 780 5¼x7½-inch pages, with many illustrations. Charles Griffin & Co., London; J. B. Lippincott Company, Philadelphia.

This edition of a well-known English book has been largely rewritten and new chapters have been added on steam turbines and superheaters. It forms a complete treatise on the steam engine and on heat as applied to steam engines, and while strictly scientific, is very mildly mathematical. There is scarcely a phase of the subject that is not discussed with sufficient fullness for most readers.

Personal.

W. Thomas Sears, mechanical engineer of the bridge and construction department of the Pennsylvania Steel Company, at Harrisburg, leaves that position February 1 to become secretary of the engineering bureau of the Niles-Bement-Pond Company, with headquarters at Philadelphia.

The firm of Pratt & Van Winkle, consulting engineers, has been dissolved. Mr. Van Winkle will continue the business in the Flatiron Building, Broadway, Fifth avenue and Twenty-third street, this city, and Mr. Pratt will devote his entire time to the interests of the Elevator Safety Company which bears his name.

The middle of January closed the fiftieth year in which Col. Olin Scott, of Bennington, Vermont, has been engaged in business. The older readers of this paper will remember Olin Scott as a frequent and always interesting contributor. He will be seventy-three years old the present month, and it is announced that he is thinking of taking a rest which he has more than earned by a life of unremitting industry. He has been identified with the machinery business of Bennington from the beginning of his career. His special line has been the inventing, designing and building of powder mill and wood pulp machinery, in which he has done a large business.

Obituary.

Henry J. Smith died in Brooklyn, January 26, sixty-nine years old. With his brother he started the Tubal Cain Iron Works in Brooklyn, which he conducted until his retirement from business four years ago.

Jean L. Pfau, formerly president of the Etna Iron Works, Chicago, died at Los Angeles, Cal., January 8, eighty-six years old. He was a native of France and settled at Quincy, Ill., where he started the business which was moved to Chicago in 1886. He retired in 1890.

Nahum B. Chamberlain, superintendent of the B. F. Sturtevant Company, Hyde Park, Mass., died January 11, sixty-three years old. He was born in Maine, entered the employ of his brother-in-law, B. F. Sturtevant, in 1859, two years after the business was started, and except for his service in the Civil War he was continuously connected with the Sturtevant works.

Joseph Marshall Wade, founder of *Wade's Fibre and Fabric*, died January 22, seventy-three years old. Mr. Wade was born near Leeds, England. He came to this country in 1850 and worked himself up thru the textile industries, being successively a weaver, a loom fixer, a designer and superintendent. He was a great lover of nature and was reputed for many eccentricities, but was highly esteemed. He became editor of the woolen department of the Boston *Journal of Commerce* and in 1885 issued the first number of *Fibre and Fabric*. He worked on all holidays and often on Sundays. He retired from business last July and a long illness preceded his death.

Edward H. Mullin, a well-known writer on electrical and mechanical subjects, died at Milburn, N. J., January 25, forty-five years old. Mr. Mullin was born in the north of Ireland, was graduated at Queen's College, Belfast, and received a medical degree at the University of Edinburgh. He came to New York in 1881 and engaged in newspaper work. 1898 he took service with the General Electric Company, at first as manager of the advertising department and latterly as a confidential representative of the company in many matters. He was the authorized representative of the company in all relations with the press and the official host of the company whenever foreign engineers or capitalists desired to visit the works or to become acquainted with its methods. Mr. Mullin had a vast number of friends both here and abroad.

In the last issue of *The Railroad Gazette* we find a eulogistic sketch (signed by the initials of Matthias N. Forney) of the career of Franklin D. Child, who died in this city January 12, sixty-two years old. Mr. Child was born in Boston and finished his schooling in the high school of that city. As a boy he was noted for his aptitude in mechanical matters. He had a shop in the cellar of his father's house which was the resort of his boy friends. He served a short term in the army in the Civil War and upon his return he went into the drawing-room of the Hinkley & Williams shops. Mr. Hinkley, one of the leading locomotive designers of his day, was then a very old man—he died in 1869—and his designs had not kept up with the times, and the responsibility of rejuvenation came upon the young man Child. "Gradually but surely a transformation took place, and instead of being somewhat awkward and ungainly machines the Hinkley locomotives were changed into structures which showed that mechanical skill of a high order had been exercised on their design." The death of Mr. Hinkley was followed by that of Mr. Williams and of the elder Child, and the company, in the hands of younger successors, was conducted for some years as the Hinkley Locomotive Works, but there was a failure and the works closed and Mr. Child was then for a year or two superintendent of the locomotive works at Providence. He returned to the Hinkley works and for some years the business was very successful, but it was closed for good and passed out of existence. Mr. Child was for a time superintendent of the locomotive works at Kingston, Canada, and for the past five or six years he was night superintendent of the Baldwin Locomotive Works in Philadelphia. Mr. Child was a strikingly handsome man. "Those who were near to him by kinship, and his friends and associates will sadly miss his pleasant smile, his charming companionship and the sincerity of his character which all admired so much while he was living, and, now that he is gone, must appreciate still more."

With the securing of the ground, near the Washington Monument, for the Exhibition of Railway Appliances in connection with the International Railway Congress the exhibition is assured, and an appeal is now sent out to the manufacturers and proposed exhibitors of railway appliances urging immediate action. Address inquiries and applications for space to J. Alexander Brown, Secretary and Director of Exhibits, American Railway Appliance Exhibition, 160 Broadway, New York city. The exhibition will be open from May 3 to May 14, inclusive.

Business Items.

The firm of Morse, Williams & Co., of Philadelphia, has opened a branch office at 1018 Penn avenue, Pittsburg.

H. B. Underwood & Co. have been making large extensions to their shops in Philadelphia. They are very busy in their portable-tool department.

The Standard Pressed Steel Company, Philadelphia, Pa., is now making pressed steel shafting hangers up to 3 7-16 inches. The company has opened a department for making all kinds of pressed steel work.

The Morse Twist Drill & Machine Company, New Bedford, Mass., has placed with J. L. Osgood, Buffalo, N. Y., a full line of its manufactures. This will enable customers in that vicinity to have orders filled promptly.

The work on the Pennsylvania Railroad tunnels under the North and East rivers, New York, is now well under way. Compressed air plays an important part in the work, and the Ingersoll-Sergeant Drill Company has furnished a total of twenty-two air compressors of various styles to the concerns which have the contracts for the work of building the tunnels.

L. Robbins, Worcester, Mass., builder of the Robbins engine lathes and patternmakers' lathes, whose product has been handled for some years by the Prentiss Tool & Supply Company as general selling agents, advises us that this selling arrangement has been terminated and hereafter he will handle the selling of lathes thru his own selling force. All correspondence and enquiries regarding his business should be addressed to his office, 42 Lagrange street, Worcester, Mass.

The Northern Engineering Works, Detroit, Mich., report among recent shipments and installations of electric and hand power cranes: Union Electric Company, Dubuque, Iowa, one 15-ton; American Production Company, one 10-ton electric; Detroit Edison Company, Delray, Mich., one 30-ton electric traveling; Edison Illuminating Company, one 7½-ton; Union Brass & Foundry Company, Lowell; Kenton Marble Company, Kenton, Ohio, one 8-ton traveling. They report an increased demand for their cranes and electric hoists, with an excellent outlook for future business.

The Westinghouse Electric & Manufacturing Company has sold to the Syracuse Railroad Construction Company apparatus for the complete equipment of the Rochester, Syracuse & Eastern Railroad. The contracts include two 1,500-kilowatt turbo-generator outfits which will generate current at 3,300 volts, three-phase and 24 cycles. Each turbo-generator will be furnished with a 50-kilo-

watt exciter, mounted on the turbine shaft. The equipment also includes two 500-kilowatt rotary converters and six 400-kilowatt rotary converters; twenty-four transformers, with a total capacity of 6,500 kilowatts; a thirteen-panel switchboard for the main generating station, and three sub-station switchboards of five panels each, as well as protective and detail apparatus. Motor equipments included in the contract call for twelve quadruple equipments of Westinghouse 110 horse-power motors, as well as eight quadruple and two double equipments of motors of other sizes.

Manufacturers.

The Perry Glove & Knitting Company, Detroit, Mich., will double its capacity.

The Ashland Iron & Mining Company is erecting a slag cement mill at Ashland, Ky.

The Brookside Mills, at Rockdale, Pa., are to be enlarged to double their present capacity.

The Golden Foundry & Machine Company, Columbus, Ga., is building an addition to its foundry.

Dufton Bros.' woolen mill in Westville, Spencer, Mass., was burned, causing a loss of $20,000.

The Vehicle Equipment Company, of New York, is building a large factory in Long Island City.

It is reported that the Great Falls, Mont., plant of the Amalgamated Copper Company may be enlarged.

The Abel & Bach Company, trunk manufacturer, of Milwaukee, Wis., will erect an addition to its plant.

An addition of 40x76 feet is being added to the plant of the Aberdeen (Wash.) Manufacturing Company.

The Sperry & Barnes Company is to build an extensive addition to its packing house in New Haven, Conn.

It is reported that plans have been completed for a large addition to the R. W. & O. shops at Oswego, N. Y.

The Sackett Screen Company, Fredonia, N. Y., has been granted a permit to build an addition to its shops.

The Magnesia-Asbestos Supply Company, Seattle, Wash., has bought some land and, it is said, will erect a factory.

George H. Houck has organized a company for the manufacture of gasoline launches at Tonawanda, N. Y.

The Virginia Stove & Manufacturing Company has been incorporated, with its principal offices at Basic City, Va.

Plans have been filed for a six-story fireproof factory, to be built for R. Hoe & Co., New York, at a cost of $165,000.

The machine shop of Strickland Brothers, at Tuscaloosa, Ala., was destroyed by fire recently, entailing a loss of $7,000.

The Superior Pin Company, Detroit, Mich., has increased its capital from $75,000 to $150,000 and will enlarge its plant.

The plant of the Paragon Plaster Company, Scranton, Pa., which was recently destroyed by fire, will be rebuilt shortly.

The Farley-Loetscher Company, Dubuque, Ia., will enlarge its plant. This company manufactures sashes, doors, blinds, etc.

An addition of 200 feet is to be built to the wood type factory of the Tubbs Manufacturing Company, at Ludington, Mich.

F. A. Bowen, of the Superior Cracker & Candy Company, Seattle, Wash., has bought land and, it is said, will put up a factory at once.

The William White & Sons Foundry Company, of Dayton, Tenn., will remove to Chattanooga in the near future and establish a large foundry.

Some of the shops of the M. C. & C. R. R. at Marietta, O., are being torn down and new ones of a more up-to-date type will be built in their place.

The Le Roy Hydraulic Electric Gas Company, Le Roy, N. Y., is putting up a new building to be used as a repair shop for gas and electric supplies.

An addition is being erected at the Standard Steel Car Works, at Butler, Pa., to provide quarters for the building of steel mail and baggage cars.

The Willson-Hayes Company, of Detroit, will establish a branch factory in Lansing, Mich., for the manufacture of sheet metal parts for automobiles.

The plant of the Bradshaw-Lapham Manufacturing Company, Seattle, Wash., manufacturer of staves, etc., has been destroyed by fire; loss, about $30,000.

The Bucyrus (O.) Cement Building Block Company has been organized and will put up a plant at once. This plant will be equipped for the hydraulic process.

The Youngstown (O.) Artificial Stone & Construction Company has secured a building in that place, which will be much enlarged and improvements made.

The Wilson-Hayes Company, of Detroit, will remove to Lansing, Mich. The company makes a specialty of sheet-iron goods, including fenders for automobiles.

The Geo. A. Just Engineering & Construction Company, New York, has bought some land in Long Island City and will erect a large manufacturing plant.

The St. Joseph Manufacturing Company, of St. Joseph, Mich., is preparing to reorganize with a capitalization of $25,000, for the purpose of extending the business.

The plant of the Lehigh-Northampton Gas & Electric Company, at Catasauqua, Pa., will be overhauled, modernized and enlarged. William W. McKee is arranging for the work.

The Unaka Lumber Company, Johnson City, Tenn., has purchased the plant of the L. McCollum Manufacturing Company, which will be enlarged and put in operation in the near future.

Miscellaneous Wants.

Advertisements will be inserted under this head at 25 cents a line each insertion. Copy should be sent to reach us not later than Saturday morning for the ensuing week's issue. Answers addressed to our care will be forwarded.

Caliper cat. free. E. G. Smith, Columbia, Pa.

Punches & dies. Wal.M.Wks., Waltham, Mass.

Wire and sheet metal working machinery and tools. Emmons Collins, Chicago.

Light mach'y to order; model work; rubber molds. J. W. Weir, Bridgeport, Conn.

Will buy or pay royalty for good patented machine or tool. Box 282, AMER. MACHINIST.

Light and fine mach'y to order; models and elec. work specialty. E. O. Chase, Newark, N. J.

A set of steel figures, size 3-32 or ⅛ in.; $1.25, post paid. J. L. Lucas, Bridgeport, Ct.

Automatic machinery designed; working drawings. Geo. M. Mayer, M. E., 1131 Monadnock, Chicago, Ill.

Salesmen of machinery supplies to handle "Lang's T-bolt heads" on commission. G. R. Lang Co., Cincinnati, O.

Automatic machinery designed and constructed by the Wellman Sole Cutting Machine Co., Medford, Mass.

Will pay cash for patent for good tool or appliance, or will manufacture on royalty. Box 255, AMERICAN MACHINIST.

Working drawings properly done by Geo. Schwarz & Co., mechanical engineers, 150 Nassau st., Room 604, New York.

Auto. machinery of all kinds designed and built; hardened and ground work, flat or circular. Wiebking, Hardinge & Co., Chicago.

Wanted—Small surface condenser pump combined; 100 to 200 square feet cooling surface; state dimensions. Address "Condenser," 49 Exchange Place, Room 1905, New York.

The Canada Machinery Company, Limited, Sarnia, Canada, have the facilities and are open to manufacture, for patentees and others, machines and machinery for the Canadian market.

Wanted—To furnish competent men for positions as managers and heads of departments in the metal-working or machine business and the past experience of each, for which there is no charge; also want competent men to register for such positions. Address James Brady, 168 Lefferts Place, Brooklyn, N. Y.

Specialties.—A large and well-known manufacturing firm (government contractors) in the Midlands, who are doing business with all the first-class engineering and motor manufacturers, is prepared to take over the sole agency for England of any useful specialty; no rubbish required; highest bankers' and commercial references given; correspondence invited. Box 2539 Sells, Fleet St., London, Eng.

Business Opportunities.

Wanted—First-class foundryman with $1,000 or more to invest in manufacturing company in lively Western town. Box 219, AMERICAN MACHINIST.

An old, high-grade manufacturing company desires another associate who will invest money with his services; good salary and dividends. Box 258, AMERICAN MACHINIST.

A thriving machine shop and foundry needs additional capital; would prefer to secure it by selling a $25,000 interest in the business to an energetic and experienced man who could take an active part in the management; have a good line. Address P. O. Box 602, Mankato, Minn.

For Sale.

For Sale—Long-established machine shop in thriving city; cause of sale, death in firm. W. D. Judson, New Haven, Conn.

I can sell your machine shop (or other business), with or without real estate, no matter where it is or what it is worth. Send description, state price and learn how. W. M. Ostranger, 111 North American Bldg., Philadelphia.

For Sale—United States patent No. 719,854, 1903, for best water gage in the world; now giving splendid results on English market; see description on page 788, December issue of POWER. Apply James Robinson, G. P. O., Leeds, England.

For Sale—A very desirable machine and repair shop, residence, location and business; manufacture wood-sawing machinery, which is in great demand; more business than can attend to; want to retire; a bargain. Irving Fox, Rochester, Minn.

For Sale—10 in. lathe patterns, drawings, jigs, templets, special tools and everything else necessary to manufacture the best 10 in. engine lathe on the market; no experiment; easy terms. Address The R. K. Le Blond Machine Tool Co., Cincinnati, O.

For Sale—A modern machine shop, complete with water power, suitable for manufacturing and jobbing purposes; is now running at Londonderry, Vt.; cause of selling, death of proprietor. Address Mrs. H. A. Hayward, Londonderry, Vt.; or Kansas City Machine Works, Kansas City, Mo.

Wants.

Situation and Help Advertisements only inserted under this head. Rate 25 cents a line for each insertion. About six words make a line. No advertisements under two lines accepted, and no advertisements abbreviated. The cash and copy should be sent to reach us not later than Saturday morning for the ensuing week's issue. Answers addressed to our care will be forwarded. Applicants may specify names to which their replies are not to be forwarded; but replies will not be returned. If not forwarded they will be destroyed without notice. Original letters of recommendation or other papers of value should not be enclosed to unknown correspondents. Only bona-fide situation want or help want advertisements inserted under this heading. Agency advertisements must be placed under Miscellaneous Wants.

Situations Wanted.

Classification indicates present address of advertiser, nothing else.

CANADA.

Young man, holding degree in engineering and having had 6 years' practical experience, desires position as engineer or a good opening; reliable recommendations. Address Box 268, AMERICAN MACHINIST.

CONNECTICUT.

Mechanical draftsman; graduate manual training school; 2 years' experience. Address Box 257, AMERICAN MACHINIST.

Position by machine designer and draftsman; thoroughly competent, trustworthy; 10 years' practical experience on automatic and special machinery, machine tools, jigs, fixtures; best references. Address "Design," care AMERICAN MACHINIST.

ENGLAND.

By an up-to-date engineer, responsible position in building steam turbines; long experience; best of references; free after February 1; West preferred. Box 173, AMER. MACH.

ILLINOIS.

Capable foreman, of 10 years' experience building engines, desires similar position; references. Box 256, AMER. MACHINIST.

Broadly qualified machine works general superintendent, desiring new location, invites confidential inquiries; state particulars. "Conservant," care AMERICAN MACHINIST.

Superintendent, age 34; wide experience manufacturing small and medium sized machinery, tools and metal specialties; knows how to handle men and turn out work; highest references. Box 248, AMER. MACHINIST.

MASSACHUSETTS.

Mechanical draftsman wishes position. Address Box 235, AMERICAN MACHINIST.

Foreman blacksmith of experience would like situation in the West; A1 reputation. Box 215, AMERICAN MACHINIST.

NEW JERSEY.

By A1 draftsman; long and varied experience enables him to tackle any design to satisfaction. Box 216, AMERICAN MACHINIST.

Draftsman, experienced on special general machinery and engineering work; New York or New Jersey preferred. Box 262, AM. M.

Machine pattern maker, first class, capable of taking charge, acquainted with molding machine practice, desires position. Box 261, AMERICAN MACHINIST.

Mechanical Publication Office—Position wanted in same, by a young man, age 22, who has practical experience and a technical education. Box 252, AMERICAN MACHINIST.

Mechanical engineer, age 34, with inventive ability and experience in designing and building special machinery, desires change; would like position with manufacturing establishment. Box 223, AMERICAN MACHINIST.

Wanted—Position as foundry superintendent, by a young man, competent to handle a large force; wide experience in green, dry sand, loam, molding machines, metal and economical foundry production; now holding similar position; A1 references. Box 250, AM. M.

NEW YORK.

Gasoline automobile designer, with best actual results, wants responsible position. Box 231, AMERICAN MACHINIST.

First-class mechanical draftsman wants to change position; New York or vicinity preferred. Box 224, AMERICAN MACHINIST.

First-class foreman; experience small and medium interchangeable work; piece and premium systems; good organizer; accurate; up to date; references. Box 184, AM. M.

Position assistant superintendent or charge medium size plant; present work, production and costs; machinist; technical graduate; successful methods; general manufacturing experience; references; age 30. Address Box 254, AMERICAN MACHINIST.

I want management of manufacturing plant, making small gas engines, light machinery or specialties in wood or metal or both, on basis of small salary and share in profits; share of cost reduction; or to produce goods at fixed price; this puts results up to me; I have had long experience in handling men, materials and machines, working out methods and systems, estimating and business details, and know what I can do. "Responsible," care AMERICAN MACHINIST.

OHIO.

Position as machine shop foreman in steam pump works; have 16 years' experience in steam pump building; desire to make change about April. Address Box 263, AM. MACH.

Designing draftsman, age 34, with experience at and ability to fill any position from shop sweeper to superintendent, wishes change; prefer East. Box 267, AMER. MACH.

Position as mechanical engineer or technical manager; wide experience; technical education; unusual knowledge of machine tools and their application for rapid production of work; thorough knowledge of electricity; a first-class man for a first-class concern. Address Box 251, AMERICAN MACHINIST.

PENNSYLVANIA.

Mechanical draftsman a technical graduate with 9 years' experience in shop and drafting room, desires position. Box 260, AM. MACH.

Mechanical engineer, expert designer and organizer, wants permanent engagement with manufacturing firm, as superintendent or engineer. Box 266, AMERICAN MACHINIST.

Mechanical engineer, expert in structural and bridge shop machinery and equipment, desires engagement with structural or machinery firm. Box 265, AMERICAN MACHINIST.

Practical gear cutting man wants position; can operate Gould & Eberhardt or Brown & Sharpe gear cutters and Gleason bevel gear planer; 10 years' experience in gearing. Box 249, AMERICAN MACHINIST.

Swedish graduate wishes a change; 6 years' experience in Sweden, 14 months in U. S. A.; general machinery, but Corliss engines especially; age 28; salary expected $100 a month; goes anywhere. Box 253, AMER. MACHINIST.

Mechanical engineer and draftsman; extensive experience engine building and general engineering; some experience in O. H. steel casting work; good business experience; accustomed to responsibility. Box 264, AM. M.

Designing engineer wishes position with structural steel concern or company building conveying apparatus; competent draftsman and qualified by experience to design and estimate on new work, alterations and improvements. Address Box 221, AMER. MACHINIST.

RHODE ISLAND.

Mechanical draftsman desires situation. Address C. W., care AMERICAN MACHINIST.

Help Wanted.

Classification indicates present address of advertiser, nothing else.

ILLINOIS.

Draftsman, mechanical, A1 on high-grade heavy power punches and presses; $175; location, Illinois. Engineering Agency, Chicago.

INDIANA.

Wanted—First-class machine shop foremen. Studebaker Bros. Mfg. Co., South Bend, Ind.

Wanted—Mechanical draftsman; one acquainted with the design of wood-working machinery. Studebaker Bros. Mfg. Co., South Bend, Ind.

MICHIGAN.

Draftsman wanted at once by large firm building light cars of all kinds and other railway supplies; must be a hustler and be able to make a neat drawing; a young man having had shop experience, who can get out shop details in a practical manner after receiving general instructions, preferred; good office accommodations and steady employment to the right party. Address H. C., care AM. MACH.

NEW JERSEY.

A few first-class lathe and vise hands wanted; only high-grade men need apply. Address or call, the Fuchs & Lang Mfg. Co., Rutherford, N. J.

Wanted—Experienced foreman for small factory; good chance for progressive man to grow with young firm; must know how to handle men and get results; experience on machine tools desired. Box 245, AM. MACH.

Wanted—First-class machinery salesman for line of special and pneumatic tools; must have ability to sell goods and establish agencies throughout the States; state age, experience and give references. Address Box 259, AMERICAN MACHINIST.

NEW YORK.

Wanted—Foreman for toolroom; preferably one experienced in pump or large machine work. Box 211, AMERICAN MACHINIST.

Wanted—Good salesmen to sell our gas engines, friction clutches and bakers' machinery. Address Box 207, AMER. MACHINIST.

Wanted—Experienced salesman to sell power presses, etc.; most excellent tools, on commission, as a side line. Box 246, AM. M.

Mechanical draftsman wanted; must be thoroughly familiar with engine, pump and compressor work; state age, experience, salary. Address E. P. C., care AMER. MACH.

Wanted—A young man with technical education in the testing department of a concern manufacturing an engineering specialty; one with some experience in a machine shop preferred. Apply by letter, "Testing," care A. M.

High-grade machinery salesman wanted to canvass jobbers and consumers for prominent engineering company; permanent, profitable position for experienced man only; state age, experience, references and salary expected. "Well Known," care AMERICAN MACHINIST.

Wanted—First-class machine shop superintendent who has thorough knowledge of machine tools, labor-saving devices, advantages of new tool steels and modern cost and record keeping methods; salary $2,500. Send full details of past experience to Hapgoods, Suite 511, 309 Broadway, New York.

Assistant foreman wanted in a machine shop near New York, employing about 100 hands; must be thoroughly competent to take charge of all lathe and planer hands; state age, salary expected, references and experience; no other form of application will be considered. Address E. M., care AM. MACH.

Wanted—Foreman for machine department (about 60 men); young man experienced in engine work preferred; must be up-to-date on latest shop practice and capable of getting out a high quality of work at low cost; give experience in detail, present and past positions filled and where, salary wanted. Box 247, AMERICAN MACHINIST.

Wanted—Factory superintendent, an experienced man, in an extensive manufacturing plant; must be accustomed to the latest and best machine shop methods and practices; to meet the requirements must be a broad-gauge man of character and ability, must know how to master details, get results and be capable of producing accurate interchangeable work advantageously; please save correspondence by stating age, experience and, in detail, responsibilities of positions filled, list of references and salary wanted. Address "Enlarging," care AMERICAN MACHINIST.

OHIO.

Superintendent—Experienced mechanical engineer to manage plant manufacturing hydraulic presses; $2,000-$2,500; excellent opportunity. Engineering Agency, Chicago, Ill.

Wanted—Repair shop superintendent; first-class man to take charge of electrical repair and machine shop; must be perfectly familiar with all types of direct-current machinery; a first-class man having thorough knowledge of rewinding and machine shop work; can command good salary. Address The Sackett Mine Supply Co., Columbus, Ohio, stating age, experience, salary expected and reference.

PENNSYLVANIA.

Machine and floor hands, familiar with machine tool work. Standard Engineering Works, Ellwood City, Pa.

Wanted—Two good diesinkers for drop forging dies. Address National Cutlery Company, 3d and Lehigh ave., Philadelphia.

Experienced mechanical draftsman wanted at once at steel works in Eastern Pennsylvania. "Mechanical," care AMER. MACH.

Wanted—Mechanical draftsman; an active young man, thoroughly up in modern automatic engines and general foundry and machine shop drawings; only those of unquestioned experience and of high character will be considered; position now open. Address, fully and promptly, "Enclosed," care AM. M.

WISCONSIN.

Wanted—A1 experienced salesman; one who has had experience in the crane line preferred. Apply or address Pawling & Harnischfeger, Milwaukee, Wis.

Wanted—Iron molders; two molders and two core makers for small gasoline engines; non-union men; those competent to make smooth, sound castings can have good wages and steady employment. Address Thomas B. Jeffery & Co., Kenosha, Wis.

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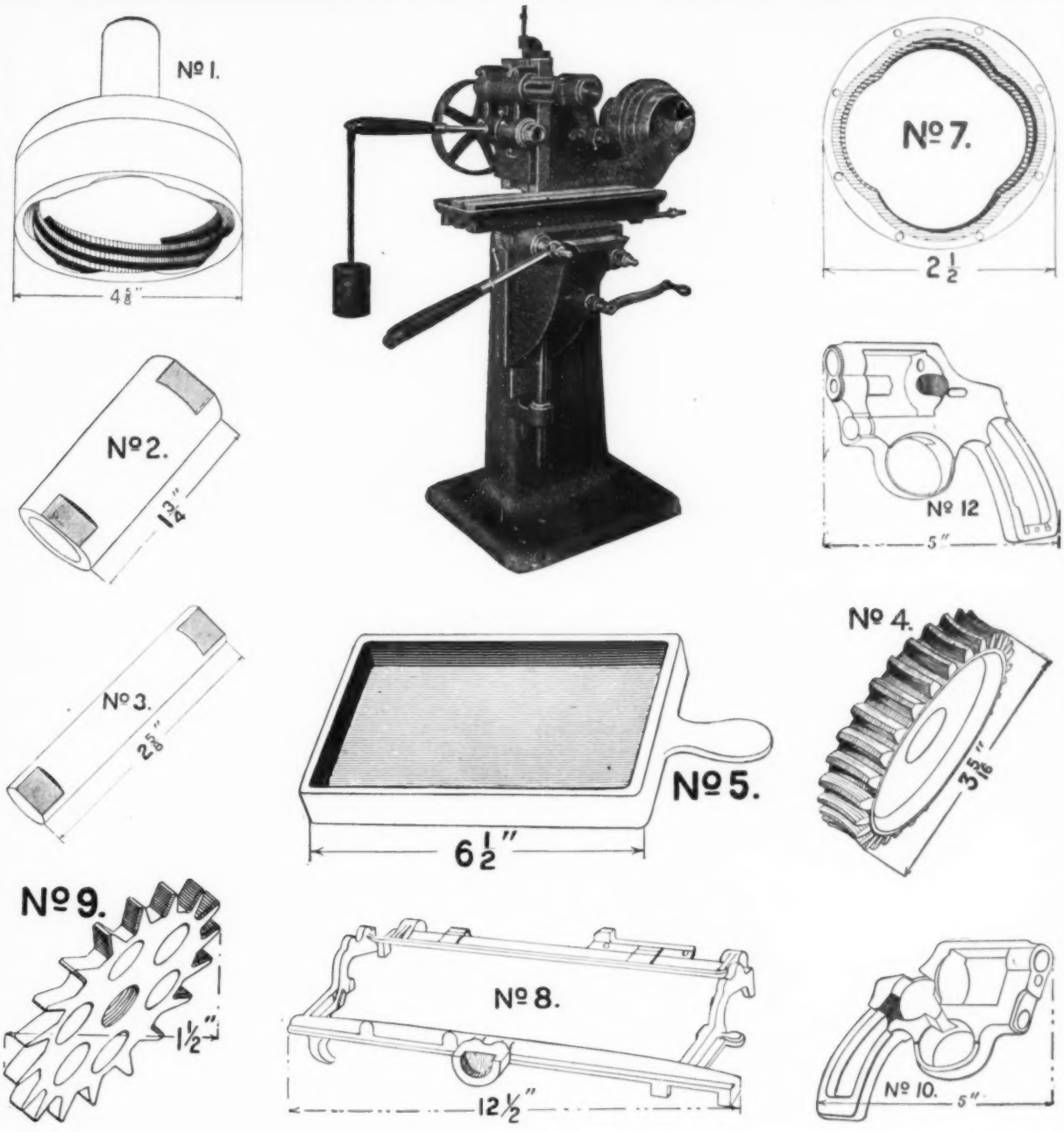

Sketches indicate parts milled on "Whitney" Hand Millers. The shaded surfaces show some of the operations.

Sketch No. 1. Part of "Brown-Lipe" Automobile Steering Gear.
" " 2. "Whitney" Roller Chain Bushing.
" " 3. "Whitney" Roller Chain Rivet.
" " 4. Worm Gear, "Whitney" Vertical Automatic Drilling Machine.
" " 5. Type Box for Small Printing Press.
" " 7. Operating Cam for "Ideal Opening Die."
" " 8 and 9. "Underwood Typewriter" Parts.
" " 10 and 12. Many of the milling operations on "Smith and Wesson" Revolvers are made on "Whitney" Hand Millers.

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Mueller Mach. Tool Co., Cin., O.
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Prentiss Tool & Supply Co., New York.
Smith Co., Chas. G., Pittsburg, Pa.
Vandyck Churchill Co., New York.

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Quint, A. D., Hartford, Conn.

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Vandyck Churchill Co., New York.
Whitney Mfg. Co., Hartford, Conn.
Wiley & Russell Mfg. Co., Greenfield Mass.

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Drills, Hand

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Hisey-Wolf Mach. Co., Cincin., O.
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Drills, Rail

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Standard Tool Co., Cleveland, O.

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Allington & Curtis Mfg. Co., Saginaw, Mich.

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Eck Dynamo & Motor Wks., Belleville, N. J.
General Electric Co., New York.
Holtzer-Cabot Elec. Co., Brookline, Mass.
Jantz & Leist Elec. Co., Cin., O.
National Elec. Co., Milwaukee, Wis.
Northern Elec. Mfg. Co., Madison, Wis.
Ridgway Dynamo & Engine Co., Ridgway, Pa.
Robbins & Myers Co., Springfield, Ohio.
Roth Bros. & Co., Chicago, Ill.
Sprague Elec. Co., New York.
Stanley Elec. Mfg. Co., Pittsfield, Mass.
Sturtevant Co., B. F. Hyde Park, Mass.
Triumph Elec. Co., Cincin., O.
Westinghouse Electric & Mfg. Co., Pittsburg, Pa.

Electrical Supplies

American Elec. & Controller Co., New York.
Clark, Jr., & Co., Jas., Louisville, Ky.
Electric Controller & Supply Co., Cleveland, O.
General Elec. Co., New York.
Northern Elec. Mfg. Co., Madison, Wis.
Roth Bros. & Co., Chicago, Ill.
Stanley Elec. Mfg. Co., Pittsfield, Mass.
Triumph Elec. Co., Cincinnati, O.
Westinghouse Electric & Mfg. Co., Pittsburg, Pa.

Electrically Driven Tools and Machinery

American Tool Wks. Co., Cin., O.
Clark, Jr. & Co., Jas., Louisville, Ky.
Electric Controller & Supply Co., Cleveland, O.
Hisey-Wolf Mach. Co., Cincin., O.

Elevators

Albro-Clem Elevator Co., Philadelphia, Pa.
Curtis & Co. Mfg. Co., St. Louis, Mo.
Morse, Williams & Co., Phila., Pa.

Emery Wheel Dressers

Desmond-Stephan Mfg. Co., Urbana, O.
Diamond Saw & Stamping Wks., Buffalo, N. Y.
Dickinson, Thos. L., New York.
Heald Machine Co., Worcester, Mass.
International Specialty Co., Detroit, Mich.
Standard Tool Co., Cleveland, O.

Emery Wheels

See Grinding Wheels.

Enclosures, Tool-room

Merritt & Co., Philadelphia, Pa.

Engineers, Consulting and Mechanical

Dawson & Gray, New York.
Hollingsworth, Sam'l, Plainfield, N. J.

Engineers, Electrical

Crocker-Wheeler Co., Ampere, N. J.

Engines, Automobile

Franklin Mfg. Co., Syracuse, N. Y.
Olds Gasoline Engine Works, Lansing Mich.
Tuttle Mfg. Co., H. A., South Norwalk, Conn.

Brown & Sharpe Mfg. Co.

Providence, R. I., U. S. A.

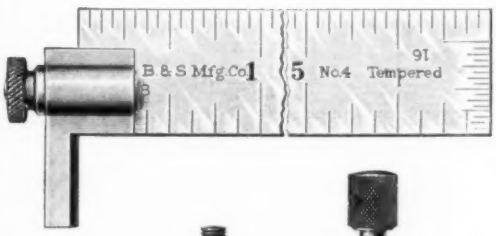
NEW TOOLS

ADDED TO THE "B. & S." LINE.

Shown in General Catalog for 1905.

Toolmakers Calipers and Dividers
3 SIZES

Hook Rules
7 SIZES



Toolmakers Clamps
5 SIZES

Toolmakers Knife Edge Straight Edges
4 SIZES

Automatic Center Punch
2 SIZES

Dial Test Indicator
No. 474

Hardware and Supply Dealers Carry These Tools In Stock

Catalog Mailed To Any Address

Engines, Gas and Gasoline
Backus Water Motor Co., Newark, N. J.
Columbus Mach. Co., Columbus, O.
Foos Gas Eng. Co., Springfield, O.
Jacobson Mach. & Mfg. Co., Warren, Pa.
Mathews, Hugh, Kansas City, Mo.
Mietz, August, New York.
New Era Gas Engine Co., Dayton, Ohio.
Olds Gasoline Engine Wks., Lansing, Mich.
Robertson Mfg. Co., Buffalo, N. Y.
Struthers-Wells Co., Warren, Pa.
Woolley Fdry. & Mach. Co., Anderson, Ind.

Engines, Oil
International Power Vehicle Co., Stamford, Conn.
Mietz, August, New York.

Engines, Steam
American Blower Co., Detroit, Mich.
Buffalo Forge Co., Buffalo, N. Y.
Frick Co., Waynesboro, Pa.
Garden City Fan Co., Chicago, Ill.
Rand Drill Co., New York.
Ridgway Dynamo & Engine Co., Ridgway, Pa.
Struthers-Wells Co., Warren, Pa.
Sturtevant Co., B. F., Hyde Park, Mass.

Engraving Machinery
Gorton Mach. Co., Geo., Racine, Wis.

Exhaust Heads
Burt Mfg. Co., Akron, O.
Sturtevant Co., B. F., Hyde Park, Mass.

Exhibition, Machinery
Philadelphia Bourse, Phila., Pa.

Fans, Electric
General Electric Co., New York.
Northern Elec. Mfg. Co., Madison, Wis.
Sprague Elec. Co., New York.
Sturtevant Co., B. F., Hyde Park, Mass.
Westinghouse Elec. & Mfg. Co., Pittsburg, Pa.

Fans, Exhaust
American Blower Co., Detroit, Mich.
Garden City Fan Co., Chicago, Ill.
Sturtevant Co., B. F., Hyde Park, Mass.

Files and Rasps
American Swiss File & Tool Co., New York.
Barnett Co., G. & H., Phila., Pa.
Hammacher, Schlemmer & Co., New York.
Montgomery & Co., New York.
Nicholson File Co., Provi., R. I.

Filing Machines
Cochrane-Bly Mach. Works, Rochester, N. Y.

Filler, Iron
Felton, Sibley & Co., Phila., Pa.

Filters, Oil
Burt Mfg. Co., Akron, O.
Houghton & Co., E. F., Philadelphia, Pa.

Fire Extinguishers
Badger & Sons Co., E. B., Boston, Mass.

Flexible Shafts
Chicago Flexible Shaft Co., Chicago, Ill.
Coates Clipper Mfg. Co., Worcester, Mass.
Gem Mfg. Co., Pittsburg, Pa.
Stow Mfg. Co., Binghamton, N. Y.

Forges
Boynton & Plummer, Worcester, Mass.
Buffalo Forge Co., Buffalo, N. Y.
Ingersoll-Sergeant Drill Co., New York.
Miner & Peck Mfg. Co., New Haven, Conn.
Sturtevant Co., B. F., Hyde Park, Mass.

Forgings, Drop
Billings & Spencer Co., Hartford, Conn.
Clapp Mfg. Co., E. D., Auburn, N. Y.
Page-Storms Drop Forge Co., Springfield, Mass.

Forgings, Drop—*Continued*
Williams & Co., J. H., Brooklyn, N. Y.
Wyman & Gordon, Worcester, Mass.

Forgings, Hydraulic
Wyman & Gordon, Worcester, Mass.

Forgings, Steel
Heppenstall Forge & Knife Co., Pittsburg, Pa.
Page-Storms Drop Forge Co., Springfield, Mass.
Wyman & Gordon, Worcester, Mass.

Forming Machines
Hartford Mch. Screw Co., Hartford, Conn.

Foundry Furnishings
Byram & Co., Detroit, Mich.
Gem Mfg. Co., Pittsburg, Pa.
Obermayer Co., S., Cincinnati, O.
Paxson Co., J. W., Phila., Pa. Cleveland, O.
Stevens, F. B., Detroit, Mich.
Sturtevant Co., B. F., Hyde Park, Mass.

Furnaces, Electric
King, Hugh E., Chicago, Ill.
Pelton & Crane, Detroit, Mich.

Furnaces, Gas
Am. Gas Furnace Co., N. Y. City.
Chicago Flexible Shaft Co., Chicago, Ill.
Westmacott Co., J. M., Providence, R. I.

Furniture, Machine Shop
New Britain Mach. Co., New Britain, Conn.

Gauges, Recording
Bristol Co., Waterbury, Conn.

Gauges, Standard
Brown & Sharpe Mfg. Co., Providence, R. I.
Morse Twist Drill & Mach. Co., New Bedford, Mass.
Pratt & Whitney Co., Hartford, Conn.
Rogers, John M., Boat, Gage & Drill Works, Gloucester City, N. J.
Sawyer Tool Mfg. Co., Fitchburg, Mass.
Slocomb Co., J. T., Prov., R. I.
Starrett Co., L. S., Athol, Mass.

Gauges, Steam
American Steam Gauge & Valve Mfg. Co., Boston, Mass.
Lunkenheimer Co., Cincinnati, O.

Gear Cutting Machinery
Adams Co., Dubuque, Iowa.
Becker-Brainard Milling Mach. Co., Hyde Park, Mass.
Bickford Drill & Tool Co., Cin., O.
Brown & Sharpe Mfg. Co., Providence, R. I.
Clough, R. M., Tolland, Conn.
Dwight Slate Machine Co., Hartford, Conn.
Fellows Gear Shaper Co., Springfield, Vt.
Foote Bros. Gear & Mch. Co., Chicago, Ill.
Ganschow, Wm., Chicago, Ill.
Gleason Works, Rochester, N. Y.
Gould & Eberhardt, Newark, N. J.
Harrington, Son & Co., Edwin, Philadelphia, Pa.
Newton Mach. Tool Wks., Philadelphia, Pa.
Niles-Bement-Pond Co., New York.
Pratt & Whitney Co., Hartford, Conn.
Sloan & Chace Mfg. Co., Newark, N. J.
Whiton Machine Co., D. E., New London, Conn.

Gear Testing Machinery
Gisholt Mach. Co., Madison, Wis.

Gears, Cut
Bilgram, Hugo, Philadelphia, Pa.
Boston Gear Works, Boston, Mass.
Brown & Sharpe Mfg. Co., Providence, R. I.
Caldwell & Son Co., H. W., Chicago, Ill.
Cresson Co., Geo. V., Phila., Pa.
Davis, Rodney, Philadelphia, Pa.
Earle Gear & Mach. Co., Philadelphia, Pa.
Eberhardt Bros. Mach. Co., Newark, N. J.
Fawcus Mch. Co., Pittsburg, Pa.
Fellows Gear Shaper Co., Springfield, Vt.

Gears, Cut—*Continued*
Foote Bros. Gear & Mach. Co., Chicago, Ill.
Ganschow, Wm., Chicago, Ill.
Gleason Works, Rochester, N. Y.
Gould & Eberhardt, Newark, N. J.
Grant Gear Works, Boston, Mass.
Hardinge Bros., Chicago, Ill.
Harrington, Son & Co., Edwin, Philadelphia, Pa.
Horsburgh & Scott Co., The, Cleveland, O.
Messmer Mfg. Co., Ferd., St. Louis, Mo.
New Process Raw Hide Co., Syracuse, N. Y.
Nuttall Co., R. D., Pittsburg, Pa.
Philadelphia Gear Wks., Philadelphia, Pa.
Sawyer Gear Wks., Cleveland, O.
Simonds Mfg. Co., Pittsburg, Pa.
Taylor, Wilson & Co., Allegheny, Pa.

Gears, Molded
Caldwell & Son Co., H. W., Chicago, Ill.
Farrel Fdry. & Mach. Co., Ansonia, Conn.
Franklin Mfg. Co., Syracuse, N. Y.
Greenwald Co., I. & E., Cincin., O.
Taylor, Wilson & Co., Allegheny, Pa.

Gears, Rawhide
Boston Gear Wks., Boston, Mass.
Chicago Raw Hide Mfg. Co., Chicago, Ill.
Earle Gear & Mach. Co., Philadelphia, Pa.
Fawcus Mch. Co., Pittsburg, Pa.
Gould & Eberhardt, Newark, N. J.
Horsburgh & Scott Co., Cleveland, Ohio.
New Process Raw Hide Co., Syracuse, N. Y.
Nuttall Co., R. D., Pittsburg, Pa.

Gears, Worm
Albro-Clem Elevator Co., Philadelphia, Pa.
Boston Gear Wks., Boston, Mass.
Fawcus Mch. Co., Pittsburg, Pa.
Gould & Eberhardt, Newark, N. J.
Grant Gear Works, Boston, Mass.
Morse, Williams & Co., Phila., Pa.
Nuttall Co., R. D., Pittsburg, Pa.
Philadelphia Gear Works, Philadelphia, Pa.
Simonds Mfg. Co., Pittsburg, Pa.
Taylor, Wilson & Co., Allegheny, Pa.

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Dixon Crucible Co., Jos., Jersey City, N. J.
Obermayer & Co., S., Cincin., O.

Grinders, Center
Coates Clipper Mfg. Co., Worcester, Mass.
Heald Mch. Co., Worcester, Mass.
Hisey-Wolf Mach. Co., Cincin., O.
Mueller Mch. Tool Co., Cin., O.
Niles-Bement-Pond Co., New York.

Grinders, Cock
Windsor Mach. Co., Windsor, Vt.

Grinders, Cutter
Automatic Mach. Co., Greenfield, Mass.
Becker-Brainard Milling Mach. Co., Hyde Park, Mass.
Brown & Sharpe Mfg. Co., Providence, R. I.
Cincinnati Milling Mach. Co., Cincinnati, O.
Garvin Machine Co., New York.
Gould & Eberhardt, Newark, N. J.
Greenfield Mach. Co., Greenfield, Mass.
Heald Mach. Co., Worcester, Mass.
Hisey-Wolf Mach. Co., Cincin., O.
Niles-Bement-Pond Co., New York.
Norton Emery Wheel Co., Worcester, Mass.
Pratt & Whitney Co., Hartford, Conn.
Rivett-Dock Co., Boston, Mass.
Smith Co., Chas. G., Pittsburg, Pa.

Grinders, Disk
Besly & Co., Chas. H., Chicago, Ill.
Diamond Mach. Co., Provi., R. I.
Heald Machine Co., Worcester, Mass.
Iroquois Mach. Co., New York.
Ransom Mfg. Co., Oshkosh, Wis.

Grinders, Drill
Heald Mch. Co., Worcester, Mass.
Niles-Bement-Pond Co., New York.
Wilmarth & Morman Co., Grand Rapids, Mich.

Grinders, Portable
Heald Machine Co., Worcester, Mass.
Hisey-Wolf Mach. Co., Cincin., O.

Grinders, Tool
Armstrong Bros. Tool Co., Chicago, Ill.
Barnes Co., W. F. & John, Rockford, Ill.
Brown & Sharpe Mfg. Co., Providence, R. I.
Diamond Mach. Co., Provi., R. I.
Gisholt Mach. Co., Madison, Wis.
Gould & Eberhardt, Newark, N. J.
Hisey-Wolf Mach. Co., Cincin., O.
Landis Tool Co., Waynesboro, Pa.
Lutter & Gies, Milwaukee, Wis.
Niles-Bement-Pond Co., New York.
Northampton Emery Wheel Co., Leeds, Mass.
Ransom Mfg. Co., Oshkosh, Wis.
Safety Emery Wheel Co., Springfield, O.
Vandyck Churchill Co., New York.
Whitney Mfg. Co., Hartford, Ct.

Grinding and Polishing Machines
Besly & Co., Chas. H., Chicago, Ill.
Blount Co., J. G., Everett, Mass.
Brown & Sharpe Mfg. Co., Providence, R. I.
Builders' Iron Foundry, Providence, R. I.
Coates Clipper Mfg. Co., Worcester, Mass.
Diamond Mach. Co., Prov., R. I.
Fairbanks Co., New York.
Goodell-Pratt Co., Greenfield, Mass.
Greenfield Mach. Co., Greenfield, Mass.
Hill, Clarke & Co., Boston, Mass.
Iroquois Mach. Co., New York.
Landis Tool Co., Waynesboro, Pa.
Marshall & Huschart Mchry. Co., Chicago, Ill.
Montgomery & Co., New York.
Niles-Bement-Pond Co., New York.
Northampton Emery Wheel Co., Leeds, Mass.
Northern Elec. Mfg. Co., Madison, Wis.
Norton Emery Wheel Co., Worcester, Mass.
Norton Grinding Co., Worcester, Mass.
Prentiss Tool & Supply Co., New York.
Ransom Mfg. Co., Oshkosh, Wis.
Rivett-Dock Co., Boston, Mass.
Safety Emery Wheel Co., Springfield, O.
Smith Co., Chas. G., Pittsburg, Pa.
Standard Tool Co., Cleveland, O.
Vandyck Churchill Co., New York.
Vitrified Wheel Co., Westfield, Mass.
Wilmarth & Morman Co., Grand Rapids, Mich.

Grinding Wheels
Adams Co., Dubuque, Iowa.
Builders' Iron Foundry, Providence, R. I.
Carborundum Co., Niagara Falls, N. Y.
Diamond Mach. Co., Prov., R. I.
Hampden Cor. Wheel Co., Brightwood, Mass.
Houghton & Co., E. F., Philadelphia, Pa.
Niles-Bement-Pond Co., New York.
Northampton Emery Wheel Co., Leeds, Mass.
Norton Emery Wheel Co., Worcester, Mass.
Safety Emery Wheel Co., Springfield, O.
Scranton Whetstone & Abrasive Wheel Co., Scranton, Pa.
Vitrified Wheel Co., Westfield, Mass.
Whitney Mfg. Co., Hartford, Ct.

Grindstones and Frames
Athol Machine Co., Athol, Mass.
Cleveland Stone Co., Cleve., O.
Lombard & Co., Boston, Mass.
Niles-Bement-Pond Co., New York.

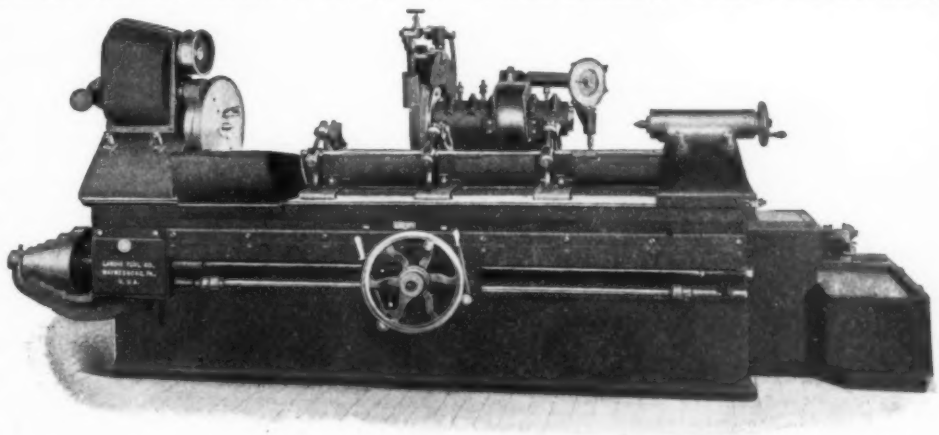
Gun Barrel Machinery
Diamond Mach. Co., Prov., R. I.
Pratt & Whitney Co., Hartford, Conn.

Hack Saw Blades Frames
Diamond Saw & Stamping Wks., Buffalo, N. Y.
Goodell-Pratt Co., Greenfield, Mass.
Hammacher, Schlemmer & Co., New York.
Millers Falls Co., New York.

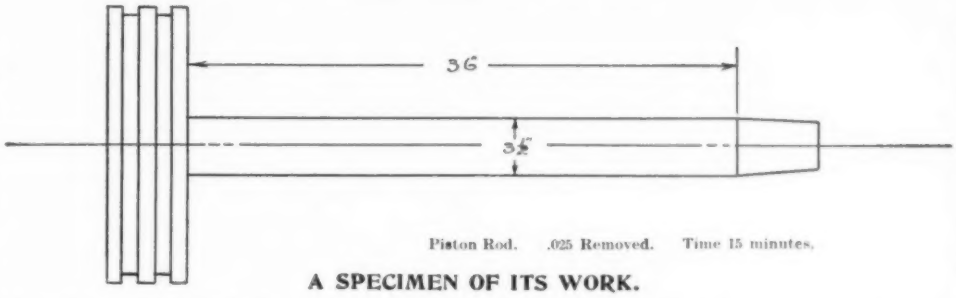
Now, Getting Down To "Brass Tacks," As They Say When Going Into Details,

we're going to assume that you're from Missouri, and have to be shown. Here's what we'll call Exhibit A—a job of grinding that might be more correctly described as a job of "Landis Grinding," because it is not likely that it can be duplicated in time and in material removed by any but the Landis method. The lines under the lower cut tell what was done and the time consumed, and this cut shows the Landis Grinder on which it was done. You can do any of the jobs that we illustrate just as well and as quickly as we have done them — they are in no way "stunts" or unusual records for the Landis grinders, for these machines are turning out similar work right this minute in all parts of the country.

If you do grinding, large or small, and want to do it in the best and cheapest way, there is absolutely no choice; you need a Landis Grinder, and nothing else will do just as well. All sorts, big and little, with only one quality—the Landis quality.



No. 27 GAP GRINDING MACHINE.



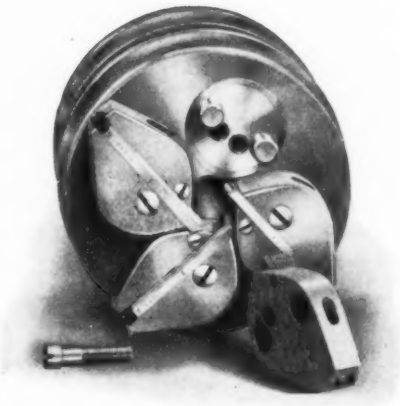
Piston Rod. .025 Removed. Time 15 minutes.

A SPECIMEN OF ITS WORK.

Landis Tool Company, Waynesboro, Pa., U.S.A.

AGENTS—Walter H. Foster Co., 513 Williamson Building, Cleveland, Ohio. Walter H. Foster Co., 114 Liberty Street, New York. C. W. Burton, Griffiths & Co., London. Schuchardt & Schutte, Berlin, Cologne, Vienna, Brussels, Stockholm, St. Petersburg, Liege, Milano, Paris and Bilbao. A. R. Williams Machinery Co., Toronto. Williams & Wilson, Montreal, Canada.

Big Improvement In Bolt Cutters.



There has always been more or less trouble with the ordinary die. It is inaccurate. It is short lived. Renewing dies is a time-consuming, tedious job. These troubles have been eliminated by the new

Landis Bolt Cutter.

The life of the die has been prolonged to 20 to 30 times that of the ordinary die. It produces results that cannot be equalled with a hobbed die. No annealing, no hobbing, no retempering or grinding in the throat.

Particulars on application.

Landis Machine Company,

WAYNESBORO, PA., U.S.A.

Hack Saw Blades and Frames—*Continued*
Montgomery & Co., New York.
Patterson, Gottfried & Hunter, Ltd., New York.
Starrett Co., L. S., Athol, Mass.
West Haven Mfg. Co., New Haven, Conn.

Hack Saws, Power
Diamond Saw & Stamping Wks., Buffalo, N. Y.
Fairbanks Co., New York.
Hoefer Mfg. Co., Freeport, Ill.
Millers Falls Co., New York.
Montgomery Co., New York.
Niles-Bement-Pond Co., New York.
West Haven Mfg. Co., New Haven, Conn.

Hammers, Drop
Billings & Spencer Co., Hartford, Conn.
Bliss Co., E. W., Brooklyn, N. Y.
Chambersburg Engineering Co., Chambersburg, Pa.
Gould & Eberhardt, Newark, N. J.
Miner & Peck Mfg. Co., New Haven, Conn.
Niles-Bement-Pond Co., New York.
Perkins Mach. Co., Warren, Mass.
Waterbury Farrel Fdry. & Mach. Co., Waterbury, Conn.

Hammers, Electric
Northern Elec. Mfg. Co., Madison, Wis.

Hammers, Pneumatic
Chicago Pneu. Tool Co., Chicago, Ill.
Cleveland Pneumatic Tool Co., Cleveland, O.
Dallett Co., Thos. H., Phila., Pa.
Ingersoll-Sergeant Drill Co., New York.
International Steam Pump Co., New York.
Niles-Bement-Pond Co., New York.
Phila. Pneu. Tool Co., Philadelphia, Pa.
Rand Drill Co., New York.

Hammers, Power
Niles-Bement-Pond Co., New York.
Scranton & Co., The, New Haven, Conn.
Sutton Co., C. E., Toledo, O.

Hammers, Steam
Bethlehem Fdry. & Mach. Co., So. Bethlehem, Pa.
Chambersburg Engineering Co., Chambersburg, Pa.
Erie Foundry Co., Erie, Pa.
Vandyck Churchill Co., New York.

Handles, Screw Plate
Standard Welding Co., Cleve., O.

Hangers, Shafting
Cresson Co., Geo. V., Phila., Pa.
Hyatt Roller Bearing Co., Harrison, N. J.
Pryibil, P., New York.
Standard Pressed Steel Co., Philadelphia, Pa.

Heaters, Feed Water
Sturtevant Co., B. F., Hyde Park, Mass.

Heating and Ventilating Apparatus
American Blower Co., Detroit, Mich.
Buffalo Forge Co., Buffalo, N. Y.
Garden City Fan Co., Chicago, Ill.
Sturtevant Co., B. F., Hyde Park, Mass.

Heating Machines
Am. Gas Furnace Co., New York.

Hoisting and Conveying Machinery
Brown Hoisting Mchry. Co., New York.
Caldwell & Son Co., H. W., Chicago, Ill.
Cresson Co., Geo. V., Phila., Pa.
Link Belt Engineering Co., Philadelphia, Pa.
Niles-Bement-Pond Co., New York.

Hoists, Electric
C & C Electric Co., New York.
Cleveland Crane & Car Co., Wickliffe, Ohio.
Curtis & Co. Mfg. Co., St. Louis, Mo.
General Pneu. Tool Co., Montour Falls, N. Y.
Maris Bros., Philadelphia, Pa.
Niles-Bement-Pond Co., New York.
Northern Engineering Works, Detroit, Mich.

Hoists, Electric—*Continued*
Sprague Electric Co., New York.
Sturtevant Co., B. F., Boston, Mass.
Yale & Towne Mfg. Co., New York.

Hoists, Hand
Harrington, Son & Co., Edwin, Philadelphia, Pa.
International Steam Pump Co., New York.
Yale & Towne Mfg. Co., New York.

Hoists, Pneumatic
Chicago Pneu. Tool Co., Chicago, Ill.
Curtis & Co. Mfg. Co., St. Louis, Mo.
General Pneumatic Tool Co., Montour Falls, N. Y.
Phila. Pneumatic Tool Co., Philadelphia, Pa.
Rand Drill Co., New York.

Igniters, Gas Engine
Franklin Mfg. Co., Syracuse, N. Y.
Remy Electric Co., Anderson, Ind.

Indicators, Speed
Norton Emery Wheel Co., Worcester, Mass.
Starrett Co., L. S., Athol, Mass.

Indicators, Speed, Peripheral
Warner Instrument Co., Beloit, Wis.

Indicators, Steam
American Steam Gauge & Valve Mfg. Co., Boston, Mass.

Industrial Railways
Hunt Co., C. W., West New Brighton, N. Y.
Sturtevant Co., B. F., Hyde Park, Mass.

Injectors
Desmond-Stephan Mfg. Co., Urbana, O.
International Specialty Co., Detroit, Mich.
Lunkenheimer Co., Cincinnati, O.
Sellers & Co., Wm., Phila., Pa.

Inspection and Tests
Hunt Co., Robt. W., Chicago Ill.

Instruction Schools
See Schools, Correspondence.

Insurance, Boiler
Hartford Steam Boiler Insp. & Ins. Co., Hartford, Conn.

Jacks, Hydraulic
Bethlehem Fdry. & Mch. Co., So. Bethlehem, Pa.
Watson-Stillman Co., New York.

Jacks, Planer
Armstrong Bros. Tool Co., Chicago, Ill.

Key Seaters
Baker Bros., Toledo, O.
Burr & Sons, Jno. T., Brooklyn, N. Y.
Chattanooga Mchry. Co., Chattanooga, Tenn.
Davis Mach. Co., W. P., Rochester, N. Y.
Niles-Bement-Pond Co., New York.
Whitney Mfg. Co., Hartford, Ct.

Keys, Machine
Standard Gauge Steel Co., Beaver Falls, Pa.
Whitney Mfg. Co., Hartford, Ct.

Lamps, Arc
General Electric Co., N. Y. City.
Stanley Elec. Mfg. Co., Pittsfield, Mass.
Westinghouse Elec. & Mfg. Co., Pittsburg, Pa.

Lamps, Incandescent
General Elec. Co., New York.
Stanley Elec. Mfg. Co., Pittsfield, Mass.
Westinghouse Elec. & Mfg. Co., Pittsburg, Pa.

Lathe Attachments
American Tool Wks. Co., Cin., O.
Bradford Machine Tool Co., Cincinnati, O.
Niles-Bement-Pond Co., New York.
Osgood, J. L., Buffalo, N. Y.
Pratt & Whitney Co., Hartford, Conn.
Sloan & Chace Mfg. Co., Newark, N. J.

Lathe Dogs
Armstrong Bros. Tool Co., Chicago, Ill.
Billings & Spencer Co., Hartford, Conn.
Besly & Co., Chas. H., Chicago, Ill.
Le Count, Wm. G., So. Norwalk, Conn.
Pratt & Whitney Co., Hartford, Conn.
Tindel-Morris Co., Eddystone, Pa.

Lathes
American Tool & Mach. Co., Boston, Mass.
American Tool Wks. Co., Cin., O.
Automatic Mach. Co., Greenfield, Mass.
Barnes Co., W. F. & John, Rockford, Ill.
Bertram & Sons Co., Ltd., John, Dundas, Ont., Canada.
Blaisdell & Co., P., Worcester, Mass.
Blount Co., J. G., Everett, Mass.
Bradford Mach. Tool Co., Cin., O.
Bullard Mach. Tool Co., Bridgeport, Conn.
Davis Mach. Co., W. P., Rochester, N. Y.
Diamond Machine Co., Prov., R. I.
Draper Mach. Tool Co., Worcester, Mass.
Dreses Mach. Tool Co., Cincin., O.
Fairbanks Co., New York.
Fay & Scott, Dexter, Me.
Flather & Co., Nashua, N. H.
Garvin Mach. Co., New York.
Gisholt Machine Co., Madison, Wis.
Greaves, Klusman & Co., Cin., O.
Harrington, Son & Co., Edwin, Philadelphia, Pa.
Hendey Mach. Co., Torrington, Ct.
Hill, Clarke & Co., Boston, Mass.
Le Blond Mach. Tool Co., R. K., Cincinnati, O.
Lodge & Shipley Mach. Tool Co., Cincinnati, O.
McCabe, J. J., New York.
Marshall & Huschart Mchry. Co., Chicago, Ill.
Mergenthaler Co., Ott., Baltimore, Md.
Motch & Merryweather Co., Cleveland, O.
New Haven Mfg. Co., New Haven, Conn.
Niles-Bement-Pond Co., New York.
Osgood, J. L., Buffalo, N. Y.
Prentiss Tool & Supply Co., New York.
Robbins, L., Worcester, Mass.
Schumacher & Boye, Cincinnati, Ohio.
Sebastian Lathe Co., Cincin., O.
Seneca Falls Mfg. Co., Seneca Falls, N. Y.
Shepard Lathe Co., Cincinnati, O.
Smith Co., Chas. G., Pittsburg, Pa.
Springfield Mch. Tool Co., Springfield, O.
Sutton Co., C. E., Toledo, O.
Vandyck Churchill Co., New York.
Von Wyck Mach. Tool Co., Cincinnati, O.

Lathes, Automatic Screw-Threading
Automatic Machine Co., Bridgeport, Conn.
Pratt & Whitney Co., Hartford, Conn.

Lathes, Bench
American Watch Tool Co., Waltham, Mass.
Blount Co., J. G., Everett, Mass.
Faneuil Watch Tool Co., Boston, Mass.
Fenn-Sadler Mch. Co., Hartford, Conn.
Hardinge Bros., Chicago, Ill.
Pratt & Whitney Co., Hartford, Conn.
Sloan & Chace Mfg. Co., Newark, N. J.
Waltham Watch Tool Co., Springfield, Mass.

Lathes, Boring
Niles-Bement-Pond Co., New York.

Lathes, Brass
Fay & Scott, Dexter, Me.
Pratt & Whitney Co., Hartford, Conn.
Springfield Mch. Tool Co., Springfield, O.

Lathes, Wood
Oliver Mchry. Co., Grand Rapids, Mich.
Seneca Falls Mfg. Co., Seneca Falls, N. Y.

Letters, Pattern
Butler, A. G., N. Y. City.

Levels
Mass. Tool Co., Greenfield Mass.
Stetson, R. O., Greenfield, Mass.

Lockers, Clothes
Merritt & Co., Philadelphia, Pa.

Lubricants
Besly & Co., Chas. H., Chicago, Ill.
Dixon Crucible Co., Jos., Jersey City, N. J.

Lubricators
Besly & Co., Chas. H., Chicago, Ill.
Detroit Lubricator Co., Detroit, Mich.
Gem Mfg. Co., Pittsburg, Pa.
Lunkenheimer Co., Cincinnati, O.

Lumber, Patternmakers'
Wuichet, Louis, Chicago, Ill.

Machinery Dealers
Baird Machy. Co., Pittsburg, Pa.
Chandler & Farquhar, Boston, Mass.
Fairbanks Co., New York.
Garvin Mch. Co., New York.
Hill, Clarke & Co., Boston, Mass.
McCabe, J. J., New York.
McDowell, Stocker Co., Chicago, Ill.
Marshall & Huschart Mchry. Co., Chicago, Ill.
Motch & Merryweather Co., Cleveland, O.
Niles-Bement-Pond Co., New York.
Prentiss Tool & Supply Co., New York.
Toomey, Frank, Philadelphia, Pa.
Vandyck Churchill Co., New York.
Wormer Machy. Co., C. C., Detroit, Mich.

Machinists' Small Tools
Athol Machine Co., Athol, Mass.
Bemis & Call Hardware & Tool Co., Springfield, Mass.
Besly & Co., Chas. H., Chicago, Ill.
Billings & Spencer Co., Hartford, Conn.
Boker & Co., Hermann, New York.
Brown & Sharpe Mfg. Co., Providence, R. I.
Cleveland Twist Drill Co., Cleveland, O.
Hammacher, Schlemmer & Co., New York.
Lufkin Rule Co., Saginaw, Mich.
Mass. Tool Co., Greenfield, Mass.
Millers Falls Co., New York.
Montgomery & Co., New York.
Patterson, Gottfried & Hunter, Ltd., New York.
Pratt & Whitney Co., Hartford, Conn.
Sawyer Tool Mfg. Co., Fitchburg, Mass.
Slocomb Co., J. T., Prov., R. I.
Starrett Co., L. S., Athol, Mass.
Stetson, R. O., Greenfield, Mass.
Wyke & Co., J., E. Boston, Mass.

Machinists' Supplies
Bemis & Call Hardware & Tool Co., Springfield, Mass.
Hammacher, Schlemmer & Co., New York.
Montgomery & Co., New York.
Whitman & Barnes Mfg. Co., Chicago, Ill.

Magnets, Lifting
Electric Controller & Supply Co., Cleveland, O.

Mandrels, Expanding
Nicholson & Co., W. H., Wilkesbarre, Pa.
Western Tool & Mfg. Co., Springfield, O.

Mandrels, Solid
Cleveland Twist Drill Co., Cleveland, O.
Morse Twist Drill & Mach. Co., New Bedford, Mass.
Pratt & Whitney Co., Hartford, Conn.
Rogers, John M., Boat, Gage & Drill Works, Gloucester City, N. J.
Standard Tool Co., Cleveland, O.

Maps
Derry-Collard Co., New York.

Measuring Machines
Pratt & Whitney Co., Hartford, Conn.
Rogers, John M., Boat, Gage & Drill Works, Gloucester City, N. J.

Mechanical Draft Apparatus
American Blower Co., Detroit, Mich.
Sturtevant Co., B. F., Hyde Park, Mass.

The United States Arsenal at Rock Island—II.

BY F. A. STANLEY.

In the preceding article an effort was made to give readers some idea of the immensity of the manufacturing establishment which our government maintains in the Mississippi Valley. And doubtless quite a good many have been as surprised as I was upon visiting Rock Island last November, to learn of the extent of this plant. For here in the East, at least, the attention of those interested in a general way in the development of the national factories, quite naturally, perhaps, has been centered more especially on the Watervliet shops and on the Springfield Armory—the latter until recently the nation's only small arms plant. Then, too, the technical press, so far as can be recalled at the moment, has never exploited the work of this Western arsenal, altho for years the establishment has been supplying the regular army and militia with such equipment as haversacks, canteens, saddles, bridles, etc., and building siege and field gun carriages, and producing material generally which is absolutely essential to the maintenance of the army and to the carrying out of the purposes for which it is maintained. The object of the present article will be to give an outline of the development of manufactures at the arsenal and to show by means of numerous engravings a few of the many important and interesting branches of work carried on there.

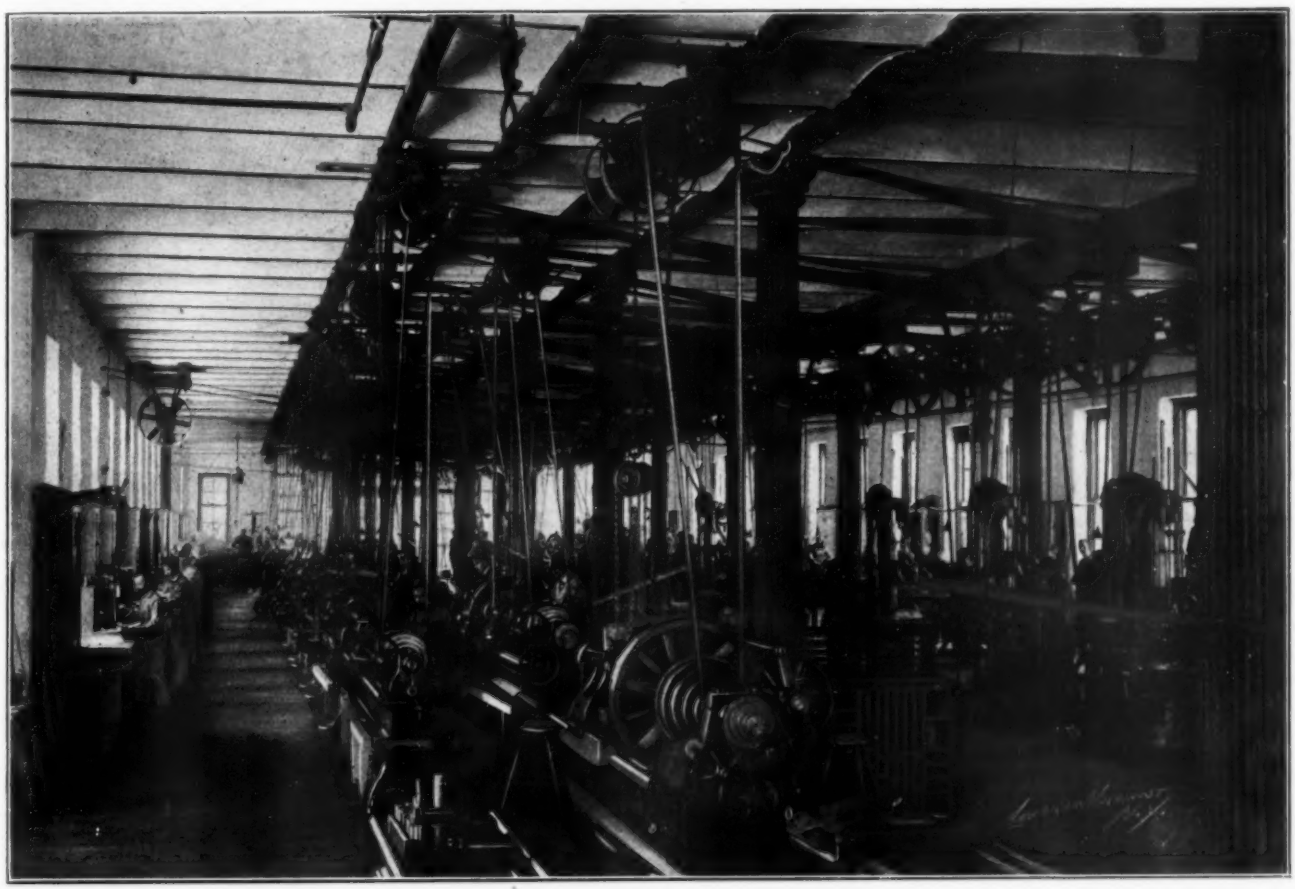


FIG. 11. VIEW IN MACHINE SHOP.

DEVELOPMENT OF MANUFACTURES.

Fortunate from its inception in the able officers assigned to its command and of whom at least two—Rodman and Buffington—have been noted inventors (the one celebrated for the gun bearing his name and for improved foundry methods developed in constructing it; the other for his disappearing gun carriage), the arsenal has been further fortunate in its location. Because of the great water power, the nearby three cities from which it may draw its workmen, the many railroad lines in the immediate vicinity which add to the possibilities of river transportation extensive facilities for shipping material by rail in all directions, the importance of the arsenal as a manufacturing and distributing center for years has been steadily increasing until it has become the principal depot for the issue of supplies to the army, and to-day, with the manufacture of the new U. S. magazine rifle well under way, the civilian force employed numbers 2,600 men—double the number at the Springfield Armory, and five times that at Watervliet. Supervising this force and its operation there are at the arsenal under the commanding officer, a major and four captains of the Ordnance Department, and to guard the grounds and buildings and perform the other duties incident to the maintenance of a military post a garrison of one hundred soldiers is regularly stationed on the island.

As noted in the previous article, when General Buffington was assigned to the command of the arsenal in 1892, very little in the way of building operations remained to be completed. But, as to manufacturing, the case was entirely different, tho, to be sure, the blacksmith shop and foundry had been operated to a certain extent; a limited amount of wood and leather work was being turned out and machine-shop operations were proceeding on a small scale. Under his charge a department was started for building carriages for siege, machine and field guns; the plant for turning out equipment for the cavalry and infantry was increased; many new and advantageous methods of handling work were devised, and the general plant was thoroughly organized for the carrying on of the branches of work then located at the arsenal. But the appropriations by Congress for new machinery had been meagre; and altho part of the product of other arsenals was sent (as it is at present) to Rock Island for storage and reissue, up to the time of the Spanish War a force of less than 500 men sufficed to carry on the work in shops and storehouses.

When hostilities opened between the United States and Spain the arsenal was under the command of the present Commandant, Lieut.-Col. (then Captain) S. E. Blunt, who relieved General Buffington in March, 1897. Immediately tremendous demands for material were made on all the arsenals, Rock Island among the rest. Departments were increased there, new machinery put in, and work carried on night and day with a total force of nearly 3,000 men, in the effort to furnish the suddenly increased army with the equipment called for. The war over, a general readjustment was made of all departments, many new machines were added and special tools and appliances devised to keep up with the requirements of the larger standing army, and to enable a large reserve of supplies to be maintained. At the same time provision was made for conveniently expanding the various departments still further if the necessity should arise.

To-day, four of the buildings in the south or Arsenal Row are taken up with general manufacturing, the remaining building—the one at the western end—is utilized as a storehouse for material to be used in manufactures. In Armory Row, which will be described later, three shops are used for small arms construction, and two at the eastern end for storehouses. In my first walk thru these shops, following a plan suggested by the commanding officer, I was able to pass thru each department in regular order without in any instance having to retrace my steps for any distance; it was merely a preliminary trip to learn in a general way the location and extent of the different branches of the work, and yet, tho it seems to me few pauses were made except to ask an occasional question and jot down a few notes, about four hours were consumed in that interesting tour of inspection.

THE MACHINE SHOP.

While the machine shop does not come first in the line of four shops operated in Arsenal Row, I believe it will be a very good point at which to take up the description of the manufacturing departments. Occupying the whole of building G, a large part of its equipment is utilized in the making of the carriage, limber and caisson for the new 3-inch field gun. On the first floor a large part of both wings is required in making the axles, recoil cylinders and other finished parts of the carriage and its equipment, and nearly the whole of the basement is occupied by the carriage assembling department. Fig. 11 is a view of the first floor, and is typical of both wings, which are well equipped with lathes, drills, screw machines, etc. Fig. 12 is a view in the basement, showing a number of gun carriages under process of erection. Fig. 13 shows a portion of the second floor in the west wing, where ammunition chests for limbers and caissons for the field gun are assembled and made ready to put in place. The traveling scaffold or millwright's platform illustrated in this engraving is used quite extensively in the various departments, and is a decided convenience for those having to look after main lines and belts, as it may be run up and down the central aisle to any point required.

The second floor of the east wing is occupied by toolmaking and milling departments; and at the front of the building is located the main drawing office, where about twenty-five draftsmen are kept busy. Blueprint and photographic rooms are close by; and immediately below, on the first floor, is the master machinist's headquarters, the inspection department being on the same floor. The top floor, or attic, serves as a pattern loft, where are stored an immense number of metal and wood patterns.

FIG. 12. FIELD GUN CARRIAGE ASSEMBLING DEPARTMENT IN MACHINE SHOP.

Of course, the machine shop does repairing for the plant; then, too, there are new appliances and special tools to build, and also quite a little work in connection with the heavier ordnance, such as 5- and 6-inch barbette carriages, etc. In all, about 650 men are at present employed in this shop. As is the case with all the other departments at the arsenal, the machine shop is electrically driven—each

FIG. 13. AMMUNITION CHEST DEPARTMENT IN MACHINE SHOP.

FIG. 14. VIEW IN FOUNDRY.

line shaft having its own motor, and most of the motors being attached to the ceiling.

In the construction of the field carriage and its limber and caisson there are a good many important operations; much of the work, especially about the recoil cylinder, is very accurate, and numerous special tools and gages have been devised to facilitate matters. An account of some of these will be given in a subsequent article dealing especially with this field piece.

THE FOUNDRY.

The foundry occupies the entire east wing of shop E, immediately west of the machine shop, and is illustrated in Fig. 14. Its two iron cupolas are well in the background in the photograph, with the jib crane in front and the core oven beyond. The two brass furnaces, with eight pots each and total capacity of 3 tons per day, are clearly shown in the foreground. This foundry has a remarkably neat and orderly appearance, and, as may be imagined, does some very nice work—especially in the line of brass and bronze castings.

THE BLACKSMITH SHOP.

Fig. 15 represents the blacksmith shop, which is located in the east wing of the structure housing the foundry, and employs about 120 workmen. It is well equipped with forges, drops, steam and helve hammers, punches, shears, etc., and is kept busily engaged getting out the various forgings required by the different manufacturing and assembling departments. The forgings on the trucks in the foreground are hollow axles of the type with which the new field carriages, as well as their accompanying limbers and caissons, are fitted.

HYDRAULIC PRESSES AND UNIQUE ACCUMULATOR.

In the same building there are two hydraulic presses, of 350 and 1,700 tons capacity respectively, which are used principally for punching and flanging steel plates for ammunition chests, drawing up steel side rails or channels entering into the construction of caisson frames, and for other heavy work of similar nature. Some of the ammunition chest plates handled here will be noticed to the left of the presses; and in the foreground is shown one of the caisson frame members and also a portion of the heavy built-up die in which it is drawn up. At present the plant is operated without an accumulator, but one is now being built which is certainly of unique construction. The principal member is the Rodman 15-inch gun, illustrated in Fig. 17. This is about 15 feet long, approximately 24 inches diameter at the muzzle and 48 inches at the largest diameter. Bushed with a bronze sleeve with 9-inch bore, this great gun will be mounted on the shaft shown under the three-legged shear, and the affair will be supported vertically by the heavy iron base seen near the end of the shaft. Passages for the liquid are provided in the shaft and gun wall; and when ready the apparatus will be set up in a pit constructed at the rear of the presses. The four links depending from the gun trunnions will be utilized in carrying tons of metal to make up the required load.

STOREROOM.

The illustration in Fig. 18 represents a storeroom containing a large number of field carriages, several howitzers, many mortars and 5-inch rifles, a long row of the latter being shown most prominently in the photograph. No heavy guns, and in fact no field guns, are made at the arsenal; but this view, which is typical of a number of storerooms, helps to bring out in an interesting manner the fact that Rock Island Arsenal is a great general supply station for the army as well as a great manufacturing establishment.

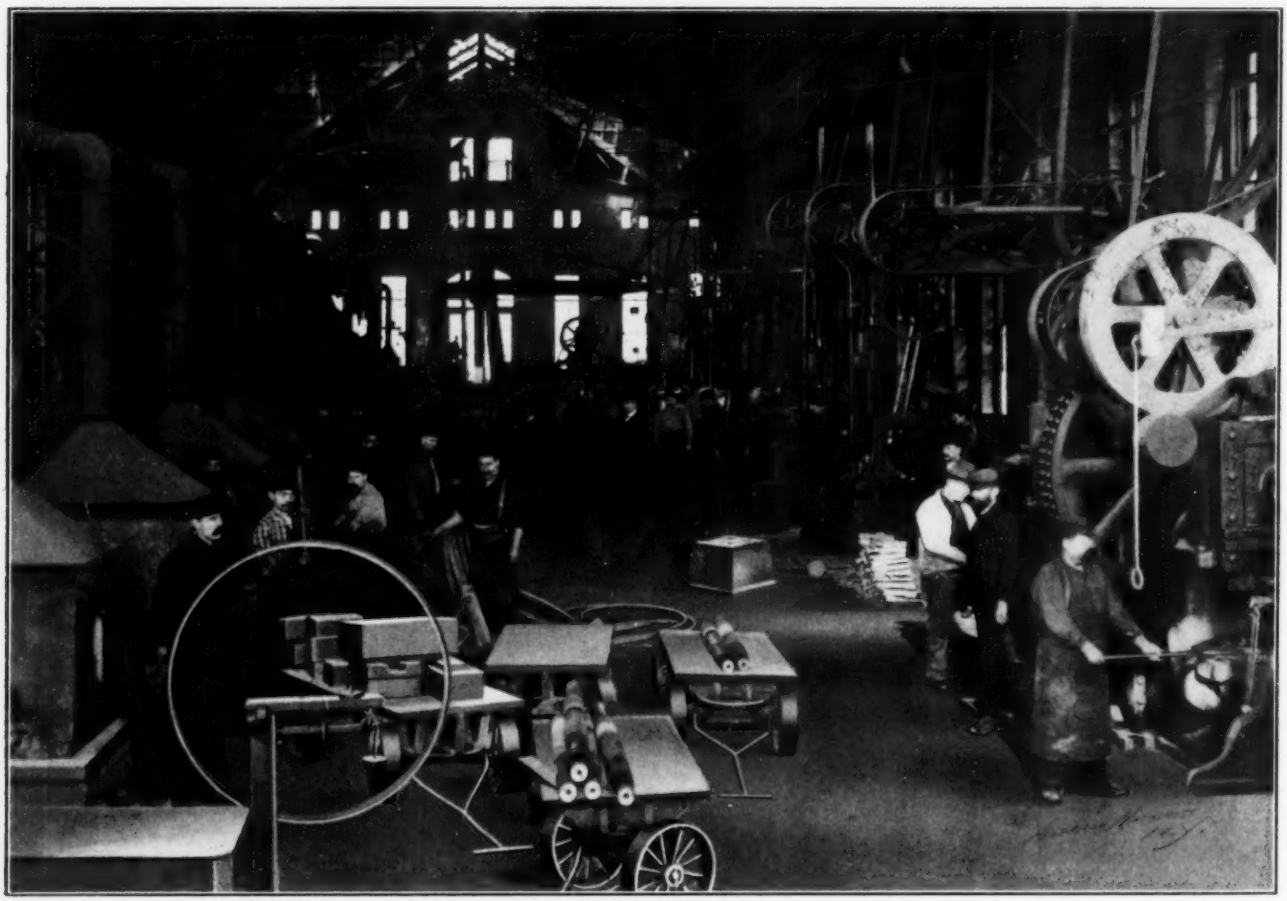


FIG. 15. VIEW IN BLACKSMITH SHOP.

As it is impossible in this issue to do justice to the equipment, harness and wood-working shops in Arsenal Row, these will be illustrated in the following number.

The government paid over $160 apiece for draft mules last year, and autotrucks and traction engines are not making them less precious.

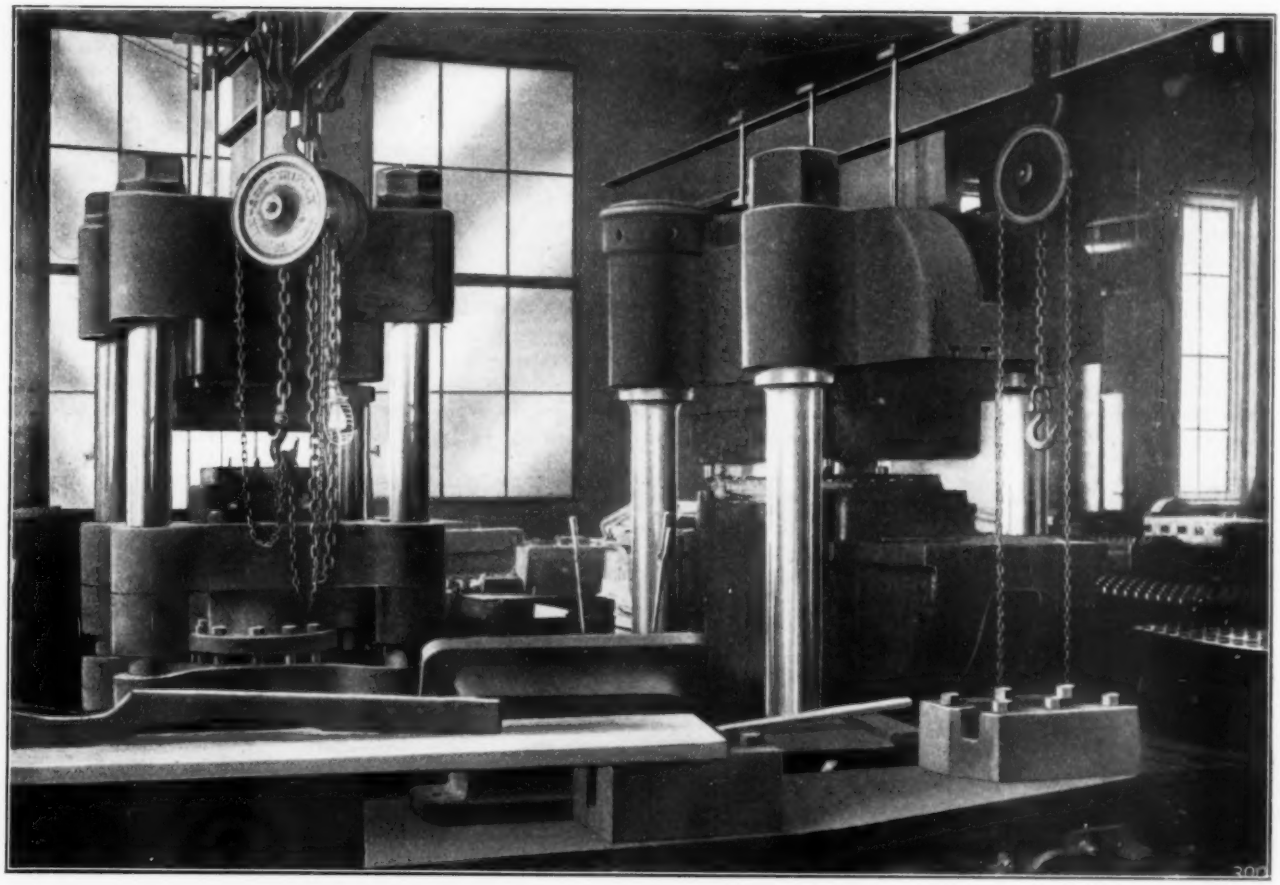


FIG. 16. HYDRAULIC PRESSES IN SMITH SHOP.

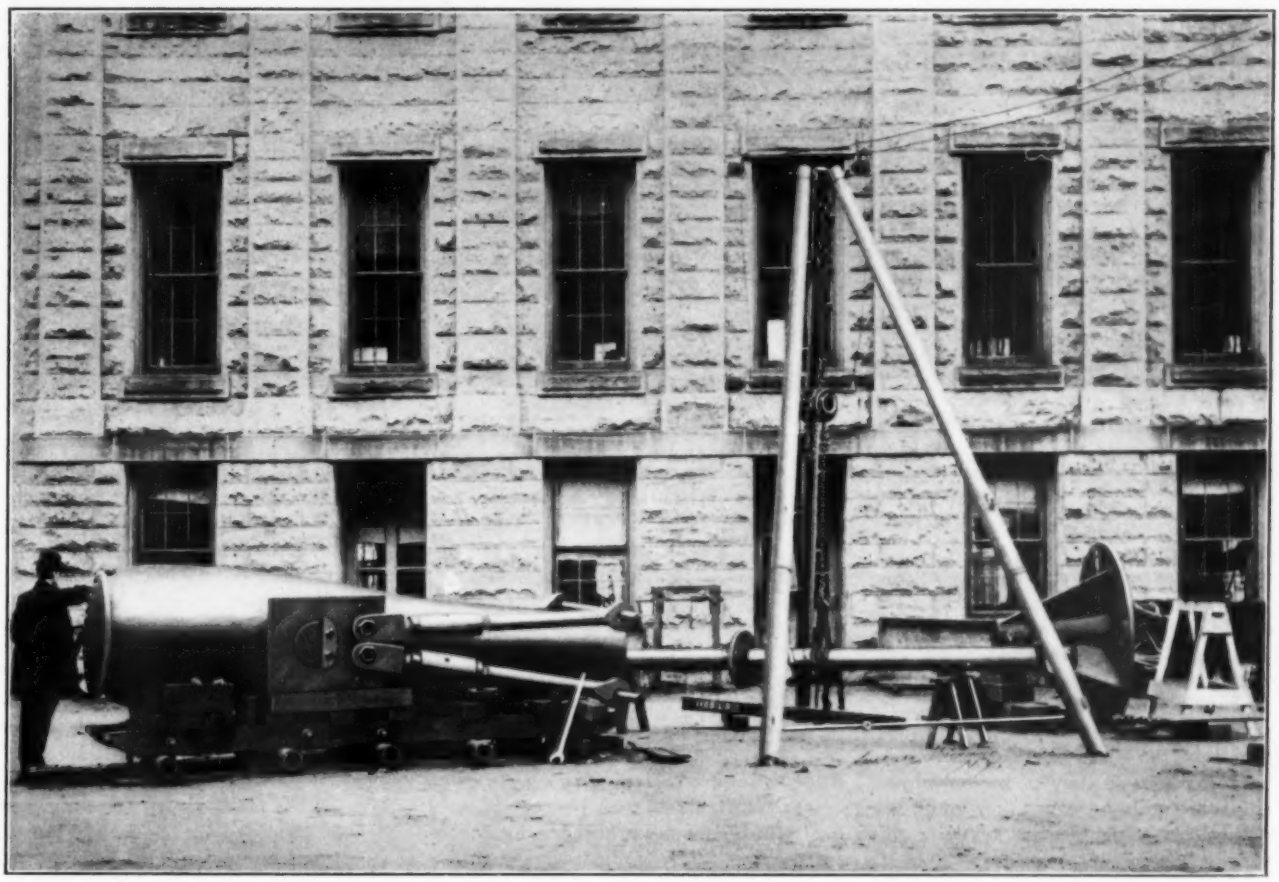


FIG. 17. 15-INCH RODMAN GUN TO BE CONVERTED INTO AN ACCUMULATOR.

For the Discouragement of Safe Crackers.

The officers of the Aetna Life Insurance Company recently found themselves unable to open the door of the big safe in their offices at Hartford, Conn., and it was only opened after eighteen days of work by safe experts. The following story is from the daily papers:

The breaking of a minute part in the mechanism of the main lock put the whole thing out of order, necessitated the work of four men, an expense of several hundred dollars and discomfort and inconvenience to the business of the company. The heroic method of boring a hole thru the seven inches of steel into the lock compartment brought about the opening of the door. A hole an inch in diameter was made. The boring had been going on for 212 hours at about the rate of one thirty-second of an inch an hour. The work was kept up night and day by hand power, the experts working in two reliefs. Thru this hole a small electric light and a mirror set at an angle on the end of a long handle were dropped, so that the cavity could be explored. Then the workmen found that the glass covering the mechanism had been so clouded by the oil and dust from the boring that they could not see the locks to find out if anything was wrong. It took several hours to break the glass. This was a difficult proposition because thru the inch hole it was hard to strike a blow against it. Then, too, it was almost a half-inch thick. When the glass had finally been broken the lever that was out of place was restored to its normal position by means of a hook at the end of an iron rod. The experts tried banging the door with heavy sledges and beams at first, hoping to dislodge any broken part in that way. But the door never quivered. The door weighs 23,000 pounds.

Adjustable Valve Motion Model.

The illustrations show a device built by Naylor, Sons & Co., of Sacramento, Cal., for the use of engineers and students who desire to know just how the valves of any engine having eccentric driven valves are acting, or to lay out the valve and eccentric positions when designing new work.

The object sought was to produce a machine at a moderate cost, rigid and accurate enough for any ordinary requirement, with the fewest possible adjustments and yet enough to cover most requirements of the engineer, builder or student. The machine is built entirely of hard brass. The crank C is secured to a block of hexagon brass having a gear secured to the opposite end of the piece; this gear meshes with two intermediate gears $I I'$; these gears in turn mesh with two other gears $E E'$ which carry two hexagon blocks secured by set-screws for adjustment to any desired angle with the crank. These blocks have grooves 3/8 inch deep by 3/8 inch wide cut into the tops of them and having blocks 3/8 inch square fitted to the grooves and held in position by set-screws, as shown. The blocks have pins 5-32 inch diameter firmly fitted into them to engage with the eccentric rods. This arrangement is in place of eccentrics, disks and straps, being more compact and accessible for adjustment. All of the gears are 32 pitch and have 36 teeth, so that either crank or eccentrics may be moved 10 degrees by lifting either of the gears I or E out of mesh and turning the desired gear one tooth forward or backward, as may be required, any position less than 10 degrees being obtained by the use of the set-screws $S S'$.

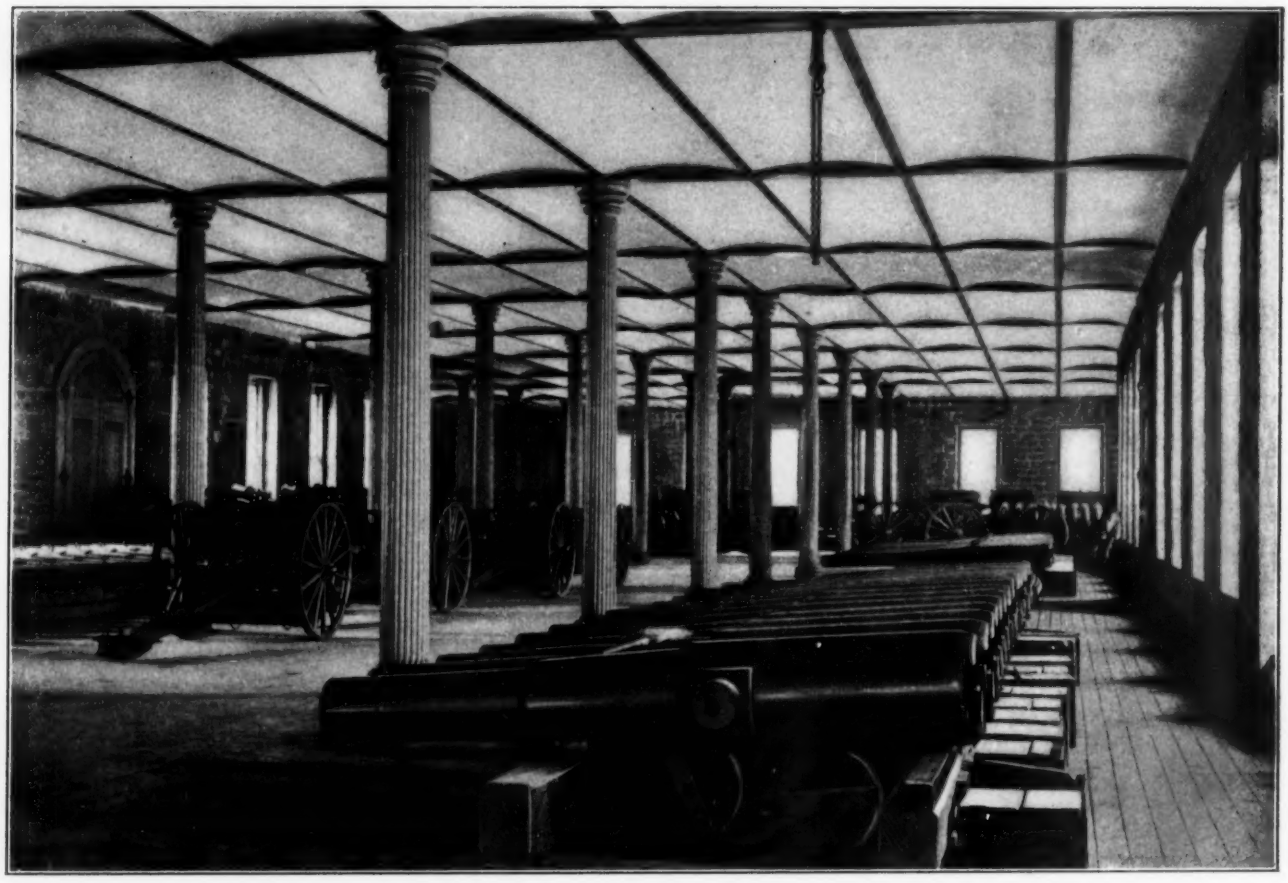


FIG. 18. VIEW IN A STOREROOM.

The stroke of eccentrics is from 0 to 1 inch. The stroke of piston is 2 inches, therefore easily divisible into percentages 1 to 100, or parts, as 1/8, 1/4, 3/8, etc.

The valves $V V'$ and piston P move in V-grooves. The tops of valves, piston and guides are flush or level so that a scale may be placed across the machine.

The connecting rod R is 6 inches, centers being three times the stroke, and eccentric rods $A A'$ are 6 inches, centers being six times the maximum travel of the valves.

To use the machine the following methods are suggested by the makers:

First lay out a diagram as shown by Fig. 1 (Zeuner boiled down), using any diameter of circle to represent the stroke

of the piston and eccentric, say 4 inches; divide off the line *A B* into any number of parts of stroke desired, as in the case shown, 25, 37½, 50, 62½ and 75 per cent., or ¼, ⅜, ½, ⅝, ¾ of the stroke. From these points on *A B* draw vertical lines to meet the circle, then from *B* produce diagonals to meet the vertical lines where they cut the circle, take the length of these diagonals and lay off vertical lines on the left-hand side of the circle, meeting the circle top and bottom. From the center of the circle produce diagonals meeting the circle where intersected by the vertical lines last laid out; then these diagonals will be the angular advance of the eccentric to the various points of cut-off, as before laid down. From the center of the circle *O* to the various vertical lines on the left of the circle measured from the line *C D* will be the linear advance of the valve. From the point of the circle at *A* to any of the vertical lines on the left of the figure will be the port opening. From the center line *C D* to the vertical lines will be the required lap. From the point *B* measured from a vertical line dropped down and produced horizontally to meet the first-named diagonals, which represent the crank advance measured horizontally, will be the period of steam admission.

Place blank cards on the valves *V* and guide *G*, turn the crank until the eccentric is at the extreme stroke either way and mark on the cards, then turn to the opposite end and mark or measure the stroke of the eccentric, and move it to suit the requirements of the case. Having set the eccentric to the required stroke, place the eccentric (by turning the crank) in the center position and lay off valve laps and ports, using the diagram before mentioned for lap, the *width* of port being laid off to suit the exhaust requirements. By this method the whole of the laying off is done on the machine with the cards fixed in position and therefore more exact than if laid off on a drawing board and then transferred to the machine.

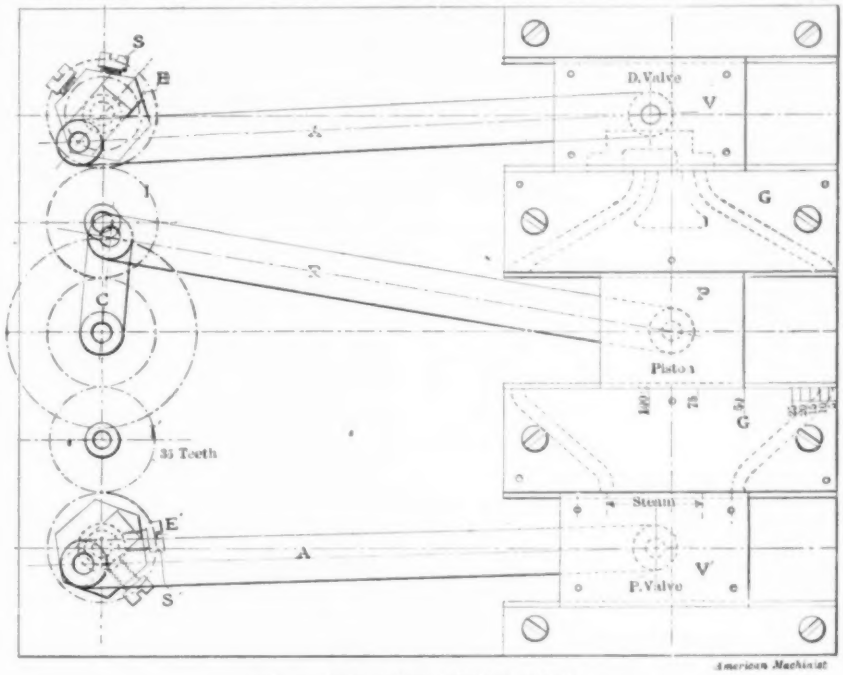


FIG. 2. THE VALVE MOTION MODEL.

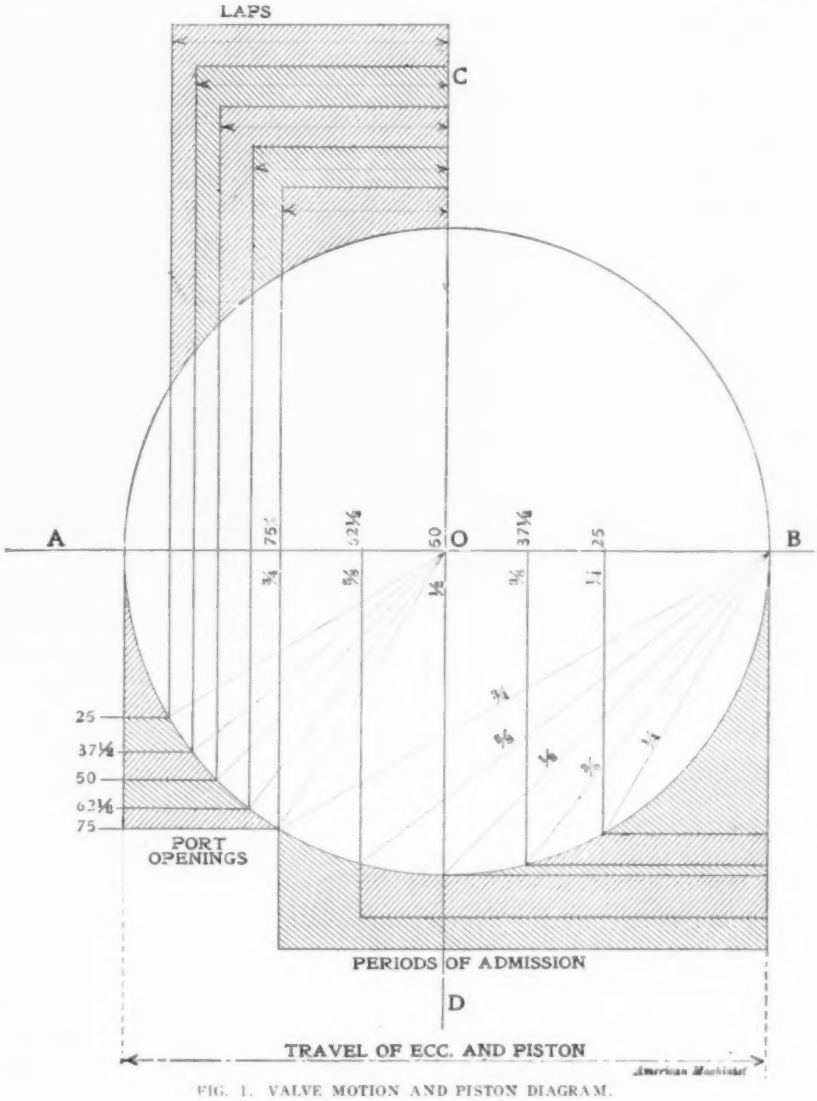


FIG. 1. VALVE MOTION AND PISTON DIAGRAM.

If two valves are to be used on the engine, use one side for steam and the other for exhaust. The diagram takes no account of lead or angularity of rod, these being shown up by the machine which is one of the principal objects sought after.

Two- or three-ported valves may of course be laid off in a similar manner. The scale of 4 inches for the diagram Fig. 1 is chosen as most convenient for the machine, as it is readily divisible into both piston and eccentric stroke of the machine. For instance, if you make ½ inch stroke of valve, then the port openings and lap are ⅛ inch of the diagram, and other measurement in like proportion. No marks whatever are placed upon the machine, these being left for the individual ideas of the user.

It is often quite difficult to pick up mercury when spilled on table or floor, on account of its tendency to divide into small, evasive globules. If a wet ring is made around the spilled mercury the globules will not readily cross it, and they may be scooped up by an improvised little shovel of paper or cardboard.

Thread Tools and Gages—I.

BY A. NORMAN.

It is some time since I have read anything in the AMERICAN MACHINIST regarding an accurate method of cutting threads. One might naturally think nothing of importance could be added to the subject nowadays, but, from things seen and experiments made in the past few years, some things have been learned which no doubt may interest some reader looking for information along this line. While hobs and chasers are not new, I believe, as to form, they are very much neglected; they are great time-savers, however, if properly made, not only on United States standard threads, but for various other forms of screw as well as worm threads.

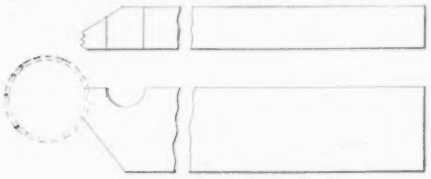


FIG. 1 Chaser Hobbed in Lathe

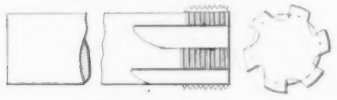


FIG. 2 Master Hob

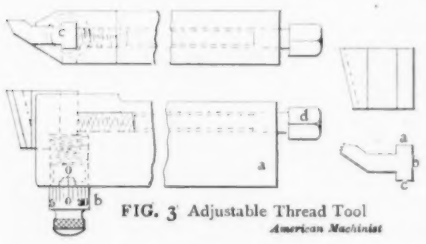


FIG. 3 Adjustable Thread Tool

American Machinist

HOBS AND CHASERS.

The old way of making thread chasers like Fig. 1, by blocking up the chaser in the tool-post of the lathe according to the pitch of the hob, and driving the latter between centers, the lathe being geared properly for the lead of the hob, and the chaser gradually fed against the hob until the full depth of tooth has been reached, is used extensively to-day even in some of the large, modern shops. It has, however, proved unsatisfactory because the form of the thread is not kept to its standard: above the center of the hob the thread is too deep, and when it is ground below the center the thread is too deep, and when the chaser is cut, say, with a 1-inch hob, the pitch angle is not the same as when cutting with the same chaser on a ⅛-inch screw. What can be more exasperating than to have the thread tear when on the finishing cut, and, when hardened, to have it expand or contract? That one little item, of the chaser tearing and changing the shape of the thread, is largely overcome by adopting a new style of chaser and a proper method of using it.

MASTER HOB THREADING TOOLS.

It is no small job to make a chaser accurately. The master hob is the first thing to make, and this is shown in Fig. 2. The diameters of master and chaser hobs of the different pitches are all the same, 1 inch being adopted as a standard size. Great care must be taken in making the master hob, as upon this depends all the threads of that particular pitch. A thread-tool holder, shown in Fig. 3, was specially designed for that class of work, and consists of a tool-steel body *a*, planed all over and drawn to a spring temper. The front end is drilled and tapped from the bottom to receive the screw *b*, which has 40 threads per inch and is formed with a head which has twenty-five graduations and is stamped like an ordinary micrometer thimble. In the upper part of the front end is cut a T-shaped groove to fit the thread tool *c*, which requires to be a good fit at the side of the blade, but not the T-head. The chaser can then be easily removed for grinding. Thru the entire length of the holder is drilled a hole which is tapped at the front end only, to receive the screw *d;* this serves to hold the thread tool securely and allows the latter to be removed for grinding without removing the holder from the tool-post. When grinding the tool, read the thousandths on the grinder dial or measure the tool before grinding; after grinding move the screw *b* up as many thousandths as have been ground off the tool, then place the latter back in the holder and fasten with the binder screw; the thread tool is now exactly in the same position as before it was ground. The single-point thread tool and the chaser are made in the customary way, but of Novo high-speed steel.

GRINDING THE THREADING TOOLS.

After the tool is hardened, the bottom and top are ground parallel, then it is placed in a gray-iron block with a T-slot cut in it to fit the back of the thread tool, and the block is tipped up at an angle of 10 degrees and held with a strap and screw while the front is ground to an angle of 60 degrees 45 minutes. I have known toolmakers to grind their thread tools to an angle of 60 degrees, measured square with the front edge of the tool, without realizing the error until it was brought to their attention. To grind the correct width of flat on the thread tool, make use of the table shown in Fig. 4; a very hard emery wheel and the whole surface of the wheel should be used for this purpose.

CUTTING AND FINISHING THE MASTER HOB.

When cutting the thread on the screw th· table in Fig. 5 will be found useful, as it shows the single and double depth of threads of different pitches, and hence is a great aid where micrometer cross feed attachments are used. The master hob is now milled across the thread the same as an ordinary tap with six grooves, and hardened in an open fire and drawn to a light straw color; it is then ground on its face in an index grinder. The most essential point in grinding a hob of this description is always to grind the cutting face radially; hence the side of the emery wheel must be in line with the center of the hob. The reason for having six cutting faces on this hob, which is so seldom used, is that when once finished it never requires any more grinding, and one may feel safe that its shape has not been disturbed thru contact with the emery wheel.

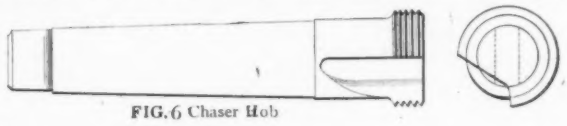


FIG. 6 Chaser Hob

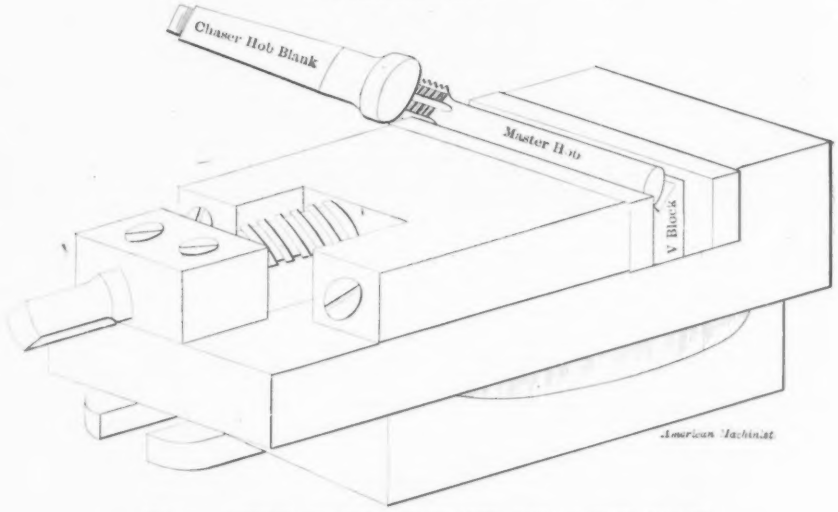


FIG. 7. METHOD OF CUTTING CHASER HOB IN THE MILLER.

As an extra precaution the hob is marked not to be ground.

MAKING THE CHASER HOB.

Upon completing the master hob, the next step is to make the chaser hob shown in Fig. 6. This is turned in a lathe to the finished size (the 1-inch standard men-

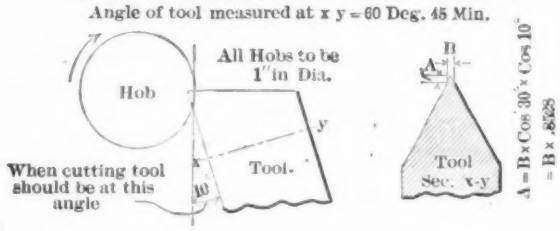
tioned) and the shank made to fit a Brown & Sharpe large milling machine collet. Collet and hob are placed in the miller spindle, and the master hob, Fig. 2, is placed in a V-block and clamped in the miller vise, as shown in Fig. 7. To set a milling machine vise perfectly parallel with the spindle of the machine, make a special arbor (without threading the end), 1¼ inches diameter and to project about 12 inches. Drive the arbor into the spin-

to the right at its slowest speed. The hob is then gradually fed against the chaser hob blank until the full depth of the thread has been reached. It is understood that the center of the cutting hob is in line with the center of the milling machine arbor when in operation. Now the master and chaser hobs are practically alike, except that the chaser hob has no thread helix, being cut straight around in order to do away with a set of tables with

chaser hob are the chasers shown in Figs. 3 and 8. These are made of high-speed steel planed on all sides, and have a cutting clearance of 10 degrees. The blank is clamped against an angle iron which in turn is bolted on the milling-machine table. The chaser hob is driven into the milling-machine collet and supported by the overhanging arm, as shown in Fig. 9. The spindle is locked in position by throwing in the back gear of the machine, or by

U. S. Standard Form of Thread

Lathe tools for cutting threads on hobs and chasers.
Angle of tool measured at x y = 60 Deg. 45 Min.

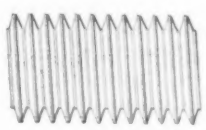


Threads per inch	Distance A	Threads per inch	Distance A	Threads per inch	Distance A
2	.0533	13	.0081	36	.0029
4	.0266	14	.0076	40	.0026
5	.0213	16	.0066	48	.0022
6	.0177	18	.0059	52	.0020
7	.0152	20	.0053	64	.0016
8	.0133	22	.0048	76	.0014
9	.0118	24	.0044	80	.0013
10	.0106	28	.0037	84	.0012
11	.0097	30	.0034	88	.0011
12	.0090	34	.0030	100	.0010

Threads per inch	Width B	Threads per inch	Width B	Threads per inch	Width B
2	.0625	13	.0096	36	.0034
4	.0312	14	.0089	40	.0031
5	.0250	16	.0078	48	.0026
6	.0208	18	.0069	52	.0024
7	.0178	20	.0062	64	.0019
8	.0156	22	.0056	76	.0018
9	.0139	24	.0052	80	.0015
10	.0125	28	.0044	84	.0014
11	.0113	30	.0041	88	.0013
12	.0104	34	.0036	100	.0012

FIG. 4.

U. S. Standard Form of Thread



TAP DRILL SIZE = DIAMETER OF SCREW — C

C = DOUBLE DEPTH OF THREAD. = $\frac{1.299}{\text{No. THREADS PER INCH}}$

Thread per inch	Double Depth of Thd.	Depth of Thd.	Thread per inch	Double Depth of Thd.	Depth of Thd.	Thread per inch	Double Depth of Thd.	Depth of Thd.	Thread per inch	Double Depth of Thd.	Depth of Thd.
1	1.2990	.6495	26	.0499	.0249	51	.0254	.0127	76	.0170	.0085
2	.6495	.3247	27	.0481	.0240	52	.0249	.0124	77	.0168	.0084
3	.4330	.2165	28	.0463	.0231	53	.0245	.0122	78	.0166	.0083
4	.3247	.1623	29	.0447	.0223	54	.0240	.0120	79	.0164	.0082
5	.2598	1299	30	.0433	.0266	55	.0236	.0118	80	.0162	.0081
6	.2165	.1082	31	.0419	.0209	56	.0231	.0115	81	.0160	.0080
7	.1855	.0927	32	.0405	.0202	57	.0227	.0113	82	.0158	.0079
8	.1623	.0811	33	.0393	.0196	58	.0223	.0111	83	.0156	.0078
9	.1443	.0721	34	.0382	.0191	59	.0220	.0110	84	.0154	.0077
10	.1299	.0649	35	.0371	.0185	60	.0216	.0108	85	.0152	.0076
11	.1180	.0590	36	.0360	.0180	61	.0212	.0106	86	.0151	.0075
12	.1082	.0541	37	.0351	.0175	62	.0209	.0104	87	.0149	.0074
13	.0999	.0499	38	.0341	.0170	63	.0206	.0103	88	.0147	.0073
14	.0927	.0463	39	.0333	.0166	64	.0202	.0101	89	.0145	.0072
15	.0866	.0433	40	.0324	.0162	65	.0199	.0099	90	.0144	.0072
16	.0811	.0455	41	.0316	.0158	66	.0196	.0098	91	.0142	.0071
17	.0764	.0382	42	.0309	.0154	67	.0193	.0096	92	.0141	.0070
18	.0721	.0360	43	.0302	.0151	68	.0191	.0095	93	.0139	.0069
19	.0683	.0341	44	.0295	.0147	69	.0188	.0094	94	.0138	.0069
20	.0649	.0324	45	.0288	.0144	70	.0185	.0092	95	.0136	.0068
21	.0618	.0309	46	.0282	.0141	71	.0182	.0091	96	.0135	.0067
22	.0590	.0285	47	.0276	.0138	72	.0180	.0090	97	.0133	.0066
23	.0564	.0282	48	.0270	.0135	73	.0177	.0088	98	.0132	.0066
24	.0541	.0270	49	.0255	.0132	74	.0175	.0087	99	.0131	.0065
25	.0519	.0259	50	.0259	.0129	75	.0173	.0086	100	.0129	.0064

FIG. 5.

dle, strap the vise to the bed, loosen the swiveling screws and open the vise 1⅜ inches, move the table up until the arbor enters in the vise, draw the table over till the arbor touches along the entire face of the fixed jaw, screw up the vise with the handle and tighten the swivel bolts; now the vise is in perfect alinement with the spindle. After everything is set in perfect order, the miller spindle is started to turn

a lot of different angles for different pitches, which are confusing when cutting the chaser for different sizes of screws; this has proven to be a more practical and neater job in all respects. The chaser hob is now milled with one groove only and hardened and drawn to a straw color. It is always ground radially.

CUTTING CHASERS.

Next in line to make by means of the

means of a wooden wedge which is tapped in between the cone and the frame of the machine after the cutting edge of the hob is accurately located. The top of face of the chaser blank and the cutting face of the hob must stand in line with each other, and at an angle of 10 degrees from the vertical center line, as shown in Fig. 10. The machine table can now be set to the right angle to suit the lead of the hob,

as shown in plan in Fig. 11, the angle *A* of table with column face ranging from 3 degrees for a hob of 8 threads per inch down to zero for a hob of 100 threads per inch. For example, if a 48-thread hob is wanted, 1½ degrees is near enough for all practical purposes—in fact, ¼ degree either side doesn't make any difference. The angle at *B* or of angle iron with table edge is the same as at *A*, the angle iron being swung in the opposite direction, as it must always be parallel with the column of the machine. When it is desired to cut a left-hand-thread chaser, the table is of course swiveled in the opposite direction, the work still being kept parallel to the column face. Now the machine is properly set up, the shape of the thread on the chaser is obtained by moving the milling-machine table, starting with cuts of two thousandths and finishing with quarter-thousandth cuts until a perfect thread is obtained on the chaser. Plenty of good

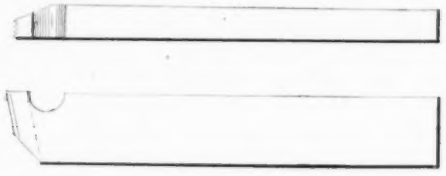


FIG. 8

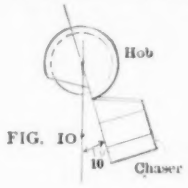
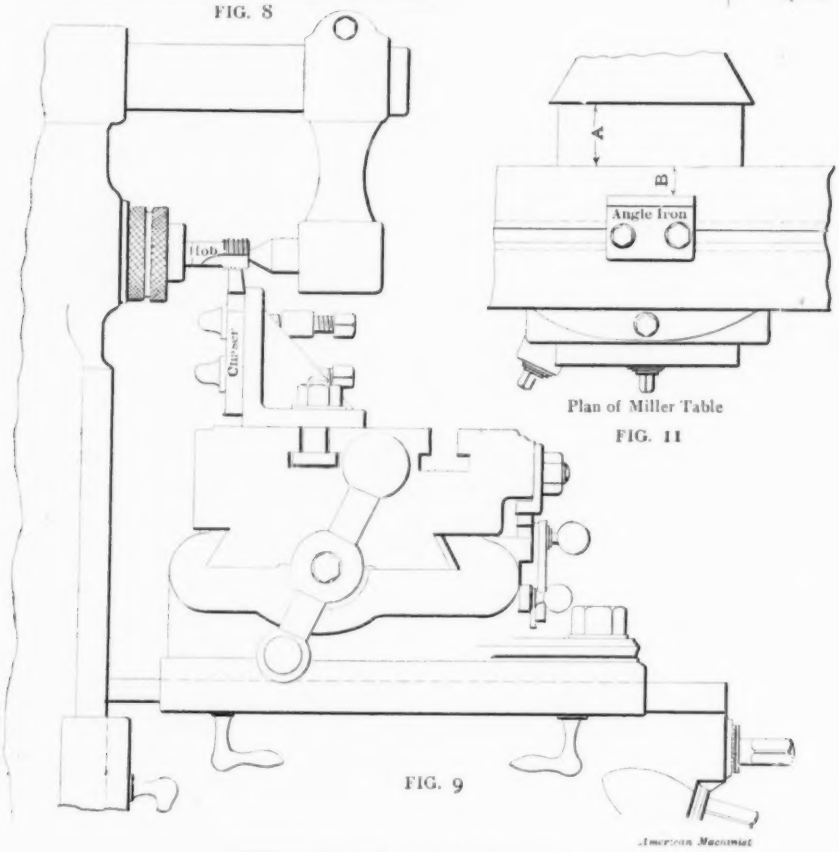


FIG. 10



Plan of Miller Table

FIG. 11

FIG. 9

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CUTTING THE CHASER IN THE MILLER.

lard oil should be used when cutting to insure a smooth thread on the work.

INSIDE CHASER.

For inside thread cutting the tool shown in Fig. 12 is used. It is an improvement over the old style, the thread being filed off on its diameter to within 1-16 inch from the cutting face, and the neck turned close to the tap size to make it more durable. On the face of the chaser is cut a square groove so that when it becomes a little worn it can be stoned off on top for the finishing cut without removing it to be ground. When stoning, bear only on the cutting edge; in that way the face will always be kept radial.

The Rusting of Steel Bedded in Concrete.

In the tenth annual report of the Boston Transit Commission the following account is given of two experiments for the purpose of determining how the rusting of iron or steel is affected by concrete:

TO INDICATE WHETHER IRON RUSTS WHEN IMBEDDED IN CONCRETE.

Nine strips of sheet iron (2x6 inches) were cleaned till their surfaces were bright and free from rust. Then they were imbedded in concrete, molded into the form of a hollow cylinder, the outside dimensions of which were 14x20 inches, the walls being 3 inches thick. This cylinder, when hardened, was kept filled with water, and was placed in the tunnel. At first the water percolated thru the concrete very readily, but the amount of percolation gradually diminished so that at the end of about two months the cylinder became practically watertight. At the end of two years the sheet iron strips were removed from the concrete and examined. They were found to be free from any rust, and in as bright condition as when placed in the concrete. The concrete was made in the proportions of 1 barrel of Portland

American Machinist

FIG. 12. INTERNAL CHASER.

cement, 9 cubic feet of stone dust and 11 cubic feet of broken stone.

TO INDICATE WHETHER STEEL IMPERFECTLY CLEANED IS PRESERVED FROM FURTHER RUSTING BY IMBEDDING THE SAME IN CONCRETE.

A square plate (4x4x½ inch), which had become badly rusted, was cleaned by filing till its general surface was bright, but the rust still remained in the numerous small pits. This plate was then surrounded by about 1½ inches of concrete, molded in the shape of a square block. The concrete was proportioned as follows: One barrel of Portland cement, 9 cubic feet of stone dust, 11 cubic feet of broken stone.

The concrete block, when hardened, was placed in water for three or four days, then taken out and dried in air for three or four days. This process of first wetting and then drying was continued for two years, and then the plate was removed from the concrete and examined. The portion of the plate that was bright had remained unchanged. There was apparently no increase of rust in the small pits, but in some of them the color had changed from the originally reddish brown to a yellow. Professor Norton, of the Massachusetts Institute of Technology, judges this to be merely a change in the composition of the old rust, and not a formation of new rust. Two other pieces of steel treated in the same way gave the same results.

We have received a pamphlet giving an account of the growth and successes of the Railroad Department of the Young Men's Christian Association for the year 1904. At sixteen points entire new buildings have been secured and other buildings enlarged or improved at a total cost of $306,000. Eleven of the new buildings are for new associations and five new associations have been organized at other points. Many associations have within the year taken up educational class work and practical lectures for the first time, resulting in a gain of over 40 per cent. in educational work. Over 9,800 members have been added, making a total membership of 72,148. We are assured that the prospects for the current year are equally gratifying, sixteen new buildings being already practically assured.

German Views of American Industries.

The following, sent by Frank H. Mason, United States Consul General at Berlin, to *Consular Reports*, and which we abridge somewhat, will not only be read with interest but may be pondered with profit by those of our readers who have the best interests of American industries at heart:

The throng of German engineers, mechanics, scientists, educators, merchants and manufacturers who went to America during the past summer, not only to see the Louisiana Purchase Exposition, but to travel over the United States and examine with expert intelligence the details of American railway management, and our agricultural and industrial methods, are now returning and relating to their neighbors and colleagues what they have seen.

It is quite worthy of note that the general tone of these reports is distinctly reassuring to the hearers before whom they have been delivered. While admitting freely the boundless resources of our country, the energy, industry and unsurpassed mechanical skill of the people, the superiority of our factory system, the speed and cheapness of rail transportation, and the restless, progressive spirit which is always looking for a new and better machine or method than the one already in use, the German experts find, or think they have found, defects in many parts of the American system, which, unless reformed, will continue to weaken our country's grasp upon international trade and promote the interests of competing nations.

There has been noticed, to begin with, on the part of our people a general feeling of complacent satisfaction with everything American, a secure conviction that whatever is done or produced by them is the best, and that they have only to keep on as they have begun to have the future securely in their hands. There is, say these critics, a pervading ignorance and indifference about everything outside the United States that, from the German standpoint, will be, unless corrected, a serious handicap in our quest for foreign trade. The careless confidence with which agents and salesmen are sent abroad, with no special preparation and with no knowledge of any language but their own, to do business in countries where only a trifling percentage of the population understand English, strikes these careful, methodical European experts as amazing. The meagerness of technical education, the trifling annual contingent of chemists, engineers, educated dyers, weavers and electricians, as compared with the throng of lawyers, physicians, dentists and unspecialized graduates turned out by our colleges and universities, seems to them shortsighted and improvident. The high standing and excellence of a half dozen great technical schools in the United States are frankly conceded; but what are these in a country of eighty millions of people in which practically every student is destined for an active and useful life?

They note the enormous disparity between American and European wages, the high rates charged by express companies, and the general heavy cost of handling business in the United States, and conclude that, on the whole, the "American danger" has been greatly exaggerated, and that a steadfast adherence by Germany to the educational system and commercial methods now in practise will leave the Fatherland little to fear in future competition with American manufactured goods.

In just what degree these observations are correct, and the resultant conclusions logical and justified, it is not the purpose of this report to inquire. Inevitably, the observations which have been here roughly summarized were made from the German standpoint by men who might naturally overlook or misunderstand much that did not conform to their theories and traditions. But the fact that such conclusions have been declared by trained observers, after several months of close observation, may well suggest the reflection whether some points in their criticism should not be taken into account.

An eminent English technician who recently visited the United States was impressed with the lack of scientific knowledge on the part of foremen and high-class operatives and the indifference on the part of their employers to the latest and highest perfections in machinery. The latter portion of this criticism is confirmed by various Americans who are engaged in supplying new labor-saving machines in Great Britain and Germany, and who find that progressive foreign firms in the metal industries are more enterprising than their American rivals in adopting up-to-date labor-saving equipments of American origin. Germany and Great Britain afford especially good markets for American machinery of the best types. Not only this, but the labor conditions abroad seem to favor the use of such perfected machinery. This opens up the latest and most important fact in the whole situation, which is that the conditions of labor, especially in the metal industries, are rapidly changing—have, indeed, changed in England and Germany since the great machinists' strike in Great Britain and since the Germans have learned that it is against America, not Europe, that their industrial strength must in future be measured.

An incident which illustrates this is related by a leading American manufacturer of machine tools and has been published on both sides of the Atlantic. The manager of a large machine shop in Berlin was about to order a new machine tool, and sent to an American factory sample pieces to be worked by it in order to ascertain precisely the time that would be saved and how well the work would be performed. The pieces were worked out and returned, with a report of the time occupied by each operation. Among others, a piece had been roughed out to the required size by an engine lathe in seven minutes. Shortly after, the American manufacturer visited the Berlin shop and was shown the written tag affixed to the piece and was told that it was absurd—that the lathe work would require at least an hour. He then offered to demonstrate that it could be done in seven minutes, the engine lathe having meanwhile arrived and having been set up ready for work. But the German foreman said: "No, that is unnecessary; if the Americans can do it in seven minutes, we can." Two days later the foreman reported that under his supervision the lathe had done the work in five minutes.

The story is pertinent only as a proof and illustration of how German shops are being supplied with the latest and most perfected machinery, and how German workmen have been taught to take the American rate of production as the standard and to work up to or even beyond it. Realizing that the future prosperity of German manufacturers will depend, as now, largely on their export trade, and consequently upon their ability to compete with those of America, German workmen of the better class have come to the conclusion that their best interest is to be as efficient and productive as possible. There is a new and pervading ambition to beat the foreigner wherever possible at his own game and with his own tools. When it is remembered that this highly educated, efficient and ambitious labor costs the employer only from one-third to one-half the wages that are paid in the United States and that it is comparatively tractable and easily managed, it will be seen that a situation is being developed here which our countrymen will do well to take into account.

In no other country is banking capital so largely, so skillfully and so effectively used to develop and sustain manufacturing industries and to market their products in foreign countries as in Germany. A large, enterprising and steadily growing merchant marine carries the products of German industry to every part of the inhabited globe. The united influences of the government, the powerful sale and trade syndicates, and of the capitalists who found banks and finance railways in new countries, are all intelligently and systematically exerted to give Germany a front place in the list of exporting nations.

An English naval cadet who, on his training ship, took eleven first prizes and in the first examination obtained ninety-seven and six-tenths per cent., was rejected at the medical examination on account of a small defect in one little toe. Still there must be rules and rules must be enforced, but it would seem that the toe might have been discovered earlier.

Manufacturing Riedler-Stumpf Steam Turbines.

BY EMIL GUARINI.

During a recent trip in Germany, I visited the works of the Allgemeine Elektricitäts Gesellschaft, Berlin, where the new Riedler-Stumpf steam turbines are at present manufactured on a large scale. Some of the accompanying photographs show views of these works, and other ones represent turbines and turbine parts as manufactured in the said works.

The Allgemeine Elektricitäts Gesellschaft, of Berlin, have been manufacturing dynamos for many years, and during the latter part of this time have been making small steam turbines, but since the development of larger turbines, their construction has been carried on in the shops of the Union Elektricitäts Gesellschaft, with whom the A. E. G. is now incorporated. Since the first of the year the steam turbines, turbine-dynamos and condensing apparatus have been made in the Union shops, a view in the testing room of which is shown in one of the accompanying illustrations. Many experiments were made before the turbines were brought to their present form.

The accompanying photographs give a good idea of some of the several phases of the building of the Riedler-Stumpf turbines as made by the above concern.

Fig. 1 shows a general view of the new turbine shops; Fig. 2 represents the assembly room with frames of small turbines; Fig. 3 shows some large turbo-alternators during the manufacture, while in Fig. 4 are seen turbines under test on the testing floor. Fig. 5 is a 75-kilowatt turbine, overhung from its frame, and Fig. 6 shows a turbine wheel of large size.

FIG. 1. GENERAL VIEW OF STEAM TURBINE SHOP.

The Proposed Combination of Harvard University and the Massachusetts Institute of Technology.

We have received the following communication from a gentleman who wishes to be known as "Tech Graduate" which we publish as a legitimate expression of opinion, not because we have any sympathy with it, for we have none.

In connection with the proposed combination of the Massachusetts Institute of Technology with Harvard University, the following authoritative statement of foreign opinion (translated from *Zeitschrift des Vereines Deutscher Ingenieure* of September 24, 1904) is of interest:

"At a meeting of the Union of German Engineers, held at Munich, September 12, with the participation of thirty eminent representatives of technological schools and universities, as well as of other schools and of industries, the following resolutions were adopted:

"1. It is not advisable, so far as can be foreseen, to attempt to meet the need of new technological schools by the addition of technological faculties to universities, but rather by the establishment of independent institutions; for the technological schools would be hindered in their independent development by attaching them to universities. This separation should not, however, impede the welcome development of intellectual good will between the two institutions. The attachment to universities would also in no way involve economies of consequence.

"2. The Union of German Engineers stands now, as before, by its expression of 1886, as follows: 'We declare that the German engineers have the same needs and will be subjected to the same judgment as to their general culture as the representatives of other professions based on higher scientific education.'

"In this view we rejoice as the conviction more and more gains ground that a considerably greater significance is to be attributed than before to mathematical and natural science as a means of culture. Knowledge of these branches is becoming more and more an indispensable constituent of general education. The predominantly linguistic education now received by the majority of our gymnasium graduates does not satisfy the demands which must be made on the leading classes of our people, in particular, in respect to the increasing significance of economic questions."

FIG. 2. ASSEMBLING ROOM, SHOWING FRAMES OF SMALL TURBINES.

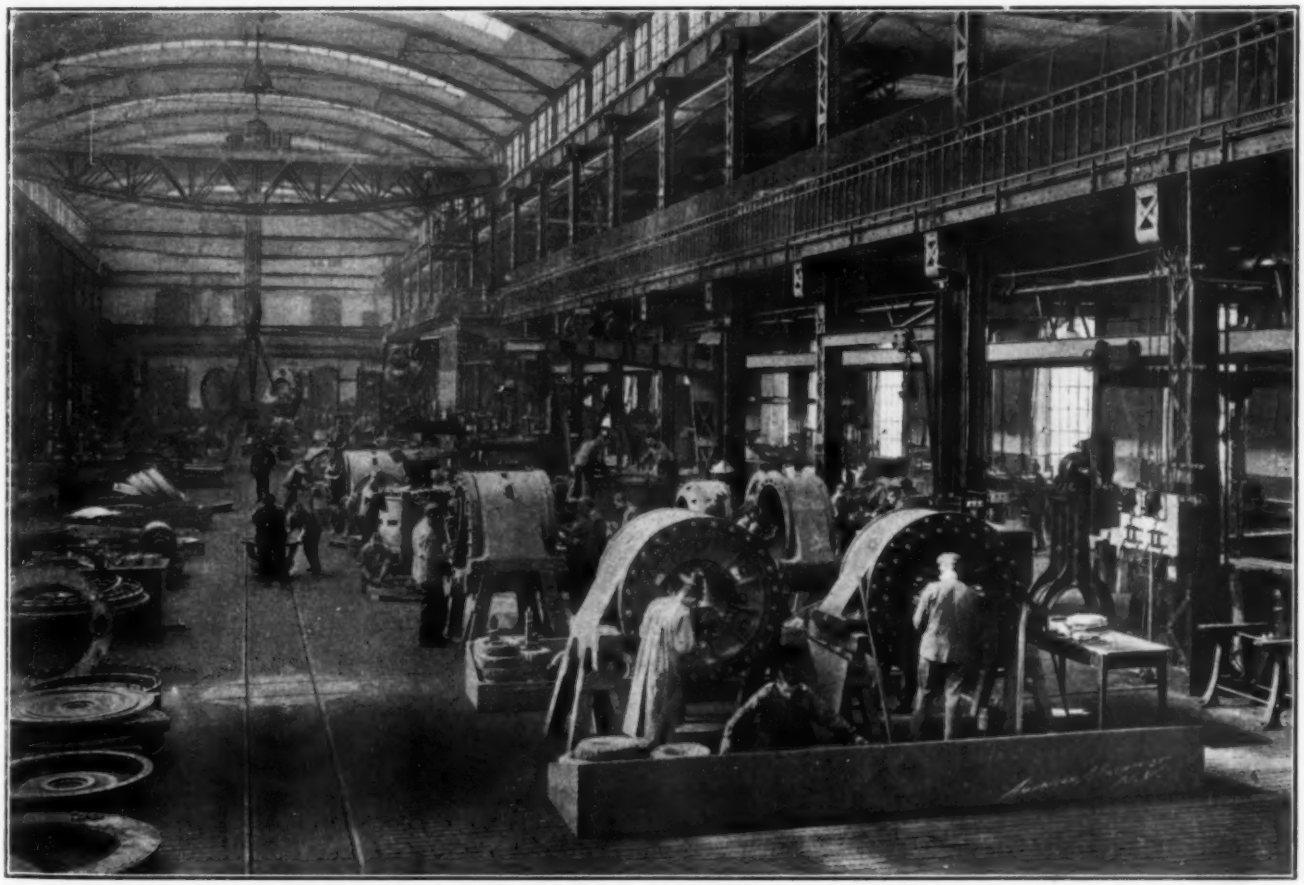


FIG. 3. LARGE TURBINE ALTERNATORS UNDER CONSTRUCTION.

Echoes From the Oil Country—A Morning Walk in the Oil Country.

Now, isn't this nice? Here is a day when the shop is not going to run, and here is a mechanical friend who wants to take a long walk with me to see what this kind of country amounts to and perhaps get some ideas, or else see where he can improve on present methods.

As this is the Oil Country it is natural for me to go where we can see the things that are peculiar to the industry. As this is "old" territory it has many things to show that would not be seen in places where the drilling for oil has been of recent date, and the first place we stop at is on a hill side, on a property that had been developed away back in the seventies and is still producing enough to be considered a good investment.

Modern and up to date do you think? No, hardly. I didn't take my new-found friend there to show him the best state of the art in oil country practise, but rather the reverse. Here were low derricks and high derricks, derricks in good repair, derricks that were ready to fall to pieces, and derricks that had fallen to pieces and lay as they had fallen. Rod lines were made of wood, iron and wire rope, and were supported in all sorts of ways. Here was a post with a cross arm, and an old end of rope tied to the arm held up the rod line. The flopping of the loose ends of the rope as the rods swayed back and forth gave an air of poverty and shiftlessness, but that old rope was not good for anything else, and it did make a splendid anti-friction joint.

An old piece of casing that was eaten full of holes was still plenty good enough to surround and guide the rod that ran thru under the railway track, while a few firmly-set posts served to carry it over the wagon road high enough to let a load of hay under. In the hollow, which is too deep to have the rod line supported by a cradle, four saplings with one bolt thru the top end furnish supports to the iron hooks that run down to the rods, and a brief examination leads to the conclusion that these same hooks are made from worn-out iron rods that had served before as rod lines.

Any kind of old bits of wood are made to do service in making a "cradle," which is nothing more nor less than a bottom piece and a couple of arms nailed to it. The tops of the arms are fastened to the rod line, and move back and forth with it, while the bottom piece rocks back and forth on the ground. The arms are made of a length suitable for the place where they are to sit, as the effort is to have the rod line run in a straight line. The ground, it will be understood, is full of various humps and hollows that have to be reckoned with. These supports have to be put in every couple of rods, and where there are thousands of feet of rod line on one lease it will not do to have them run hard, and as they are exposed to the weather they need renewing at intervals. The first cost of them must be very low, or it would cost too much to rig up and keep a lease going, and for the same reason the cost of repairs also must be low.

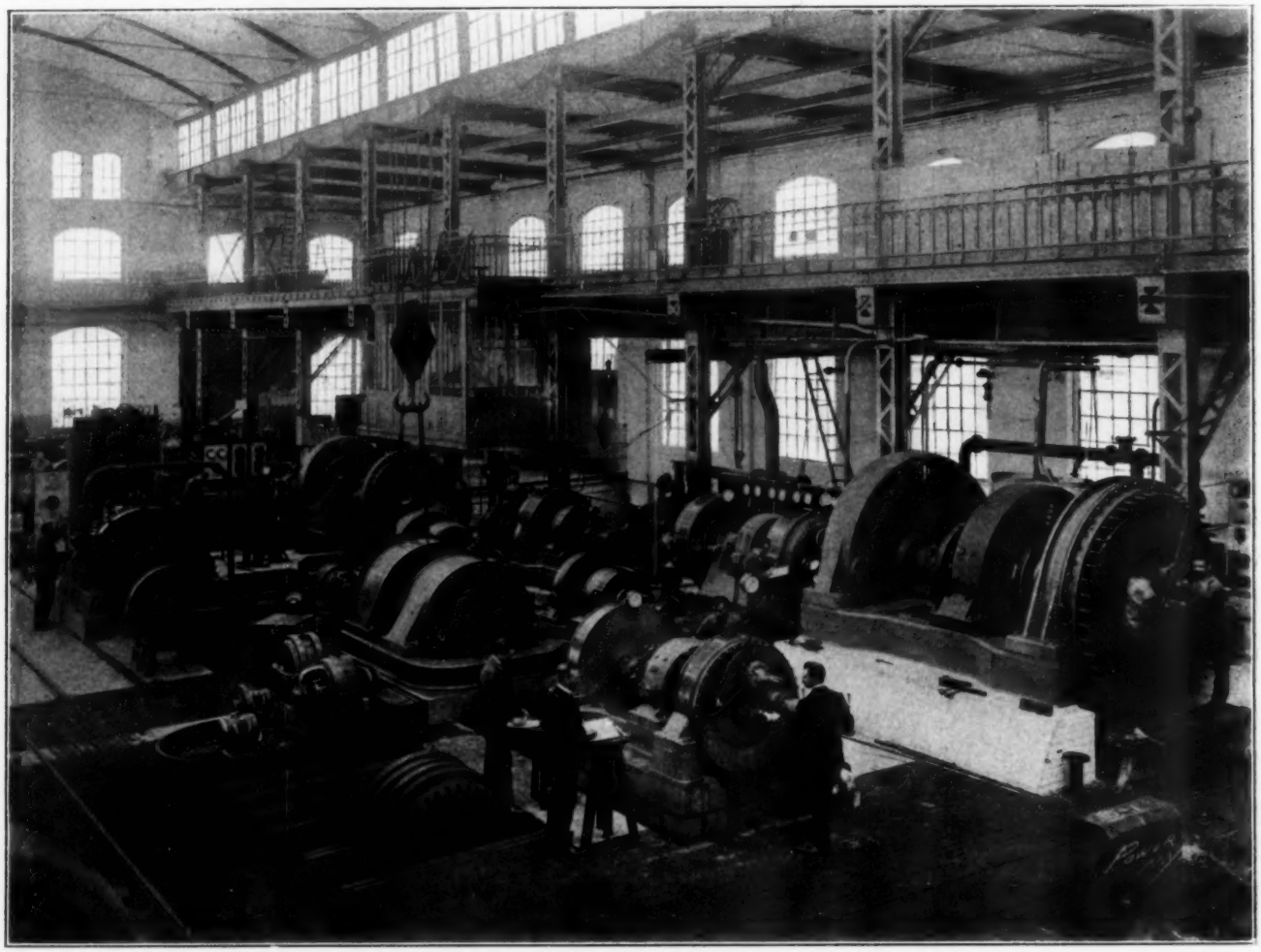


FIG. 4. TURBINES UNDER TEST.

My friend looked at all of these things and at the tangle of pipe lines that ran hither and thither over the ground—big lines, little lines, old lines, new lines, water lines, gas lines, oil lines, steam lines, lines in use and lines not in use. He tried to follow them to see the use to which they might be put. One ran down a well. "What do you think that is for?" he asked. I knew it was for either steam or gas, but was not sure which, and so went and pulled a little wooden plug out of a hole and applied my nose. "No gas there," I remarked; "it must be a steam line." And I whittled another plug and

drove into the hole, while he looked on inquiringly.

"This line has been frozen at some time, and these holes were punched in to drain out the fluid. If it is a steam line they will let the water out as the steam works along, and if it is a gas line they serve to let out the gasoline. A wooden plug will last until it rots, and then it is easy to put in another one. A little water in an oil line will often freeze and give trouble, and the man will hunt it going along and tapping on the line with a hammer. When he finds it he will punch a hole in the line and then build a fire around it and thaw out the water and let it run out of the hole. In the case of an oil line the hole is generally tapped and an iron plug is put in, especially if it is a line that the oil is pumped thru."

He looked over the rotting timbers around some of the wells where there was just enough good material supplied from time to time to keep the wells going. He looked at the old collection of cast-off iron shaft and flanges and derrick timbers that together made up a turntable. He saw how the combination of a piece of old rope and a stake driven into the ground gave a change in direction that gave the minimum of friction. He listened to the voices peculiar to a lease, voices that might cause agony to a nervous person, but were music to the man who ran the lease. There were voices caused by the slowly pulling back and forth of wood on wood, or of wood on iron, or of iron on iron, all innocent of any lubrication; for be it understood that it is not the practise to waste good oil where none is needed; and then it would take time to oil all of these thousands of places, even if the oil did not cost anything. He saw motion being transmitted around a corner by means of a growing tree and a piece of timber with a very little iron on it. These and many more things he saw here, and all being done with a collection of material which he would have considered dear as a gift.

"This is certainly *adaptive* engineering," he remarked. "Oil is what they are after, and if only they get that with the least expense, any plan they make use of is a success. How much oil do you suppose this man gets?"

"Possibly sixty or seventy barrels a month," I reply.

"You don't mean to say that that is all the oil he gets from all of these wells!" he exclaimed. "Why, there must be twenty or more of them."

"I know it, and if he averages a quarter of a barrel apiece from the lot, he is lucky. Lots of leases will not do it. You hear of the big wells, but it is the little fellows that keep at it for years that swell the production and keep it swelled."

"If that is really all the oil these wells give I don't wonder that the owner uses up all the old stuff he can. He wouldn't have anything left if he didn't."

We go on up past the place where a steam engine is lying. I can remember it for many years, and it looked then, when first I saw it, as if it had been years since it had run. It is of a style that has not been sent into this country for at least twenty-five years. It is rusting away, forgotten by the owner (perhaps the former owner is dead or has sold the lease to the present owner, who does not know it is here), and unheeded by the man who runs the lease.

FIG. 6. WHEEL OF A REIDLER-STUMPF TURBINE.

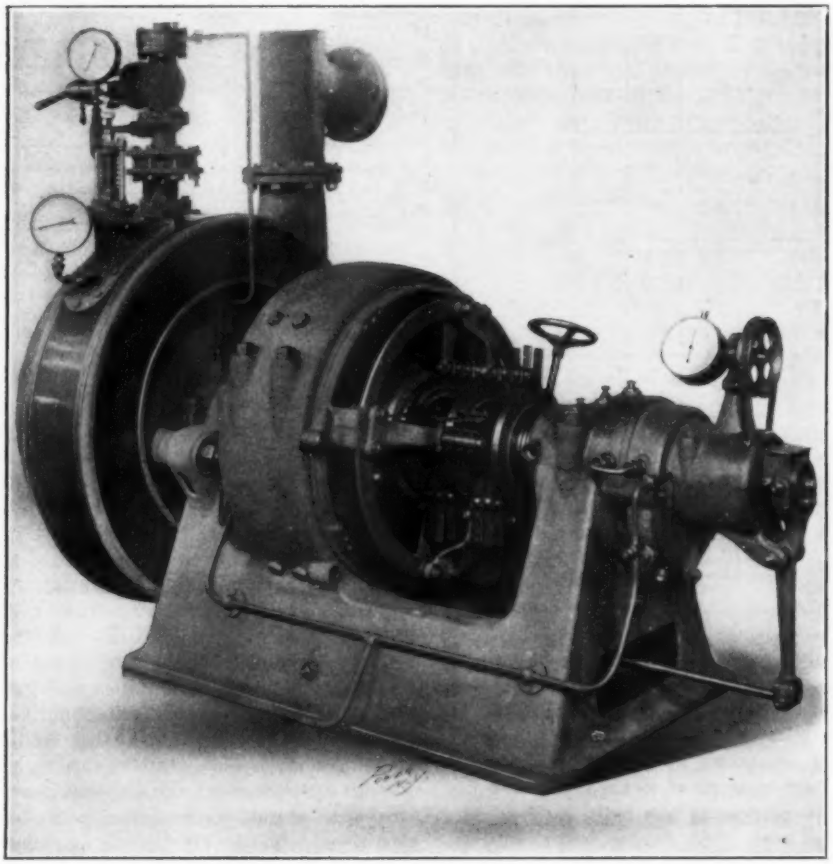


FIG. 5. IVERBUNG TURBINE.

The substantial character of the work where the main lines of a lease pass under us (we are on the line of an electric railway) shows that here is a paying lease that is run by a business man who knows that it means loss to have things break down.

Soon we leave the railway and begin climbing toward the crest of the hill. At the top we find the center of another lease. Here can be seen the march of events. Three old boilers have finished their usefulness, and each one speaks of a different age. The oldest one tells of a time when the earliest work was being done, and inquiry shows that this lease was one of the pioneers in this section, and we are near to the birthplace of the industry.

The man who runs the lease comes down from his house, which is a few rods away, and seems to be glad to see someone who is interested in his work. He explains that they did not throw out the steam engine because it had given out, but because the boiler had either to be replaced or very generally repaired, and it was cheaper to put in a gas engine. That steam engine had been built by a local firm some twenty-three or four years before this time, and had been doing work here ever since it had been used to drill some of the wells.

The lease would furnish plenty of gas to supply the gas engine, altho it did not supply enough to generate sufficient steam for the steam engine.

He showed us where he had run a line to his chicken house to keep it warm, and how an over pressure had nearly burned the house down, as a blackened end showed. Before we left he brought forth a big pitcher full of fine cider and urged us to empty it. To show that we appreciated his desire to be friendly we did our best to please him, and as we both like cider we pleased ourselves at the same time.

Standing where we were we could see for miles, and our view was the tops of other wooded hills, some with oil wells on them and some without, but without many other signs of civilization, altho we were not much more than a mile in a straight line from a thriving city of about 15,000 inhabitants.

We continue on our way, and go down over the other side of the hill, down over the place where there had been a yard, past the spot where a house had been, past a place where a pile of ashes alone showed that at some time it had been the center of a lease now entirely disappeared, past the grass-covered hole where the old conductor pipe showed in the lowest point to prove that it had once been an oil well; down for hundreds of feet, thru barbed wire fences, under and over rod lines, and over pipes, and thru dense thickets to the bottom of the gulch.

All up and down this gulch oil wells are scattered, and a look at them brings out the often asked and never fully answered question, "Why did they put that well in that particular spot?" and that spot this time chanced to be a most inaccessible spot on the hill side, and much the worst spot in sight. This naturally brought up another just as difficult question of, "Why is this piece of land covered with wells while that one has none on it?" All down the road we talked of these things until the street car line was reached and the time came when we parted.

I have not told of his contributions to my stock of knowledge of the doings in other places. I received much valuable and interesting information such as one gives a friend whom he has not seen for some time, and which concerned matters and people of whom I had heard but never seen, and with whom he was well acquainted.

From having studied along the same general lines, and having read the same mechanical papers for years, and having been buffeted in the same sea of sink-or-swim mechanics, we touched in so many places that it was hard for me to think, as I shook hands with him, that I was parting with one whom I had seen and heard of for the first time the day before, and not with the friend of years.

W. OSBORNE.

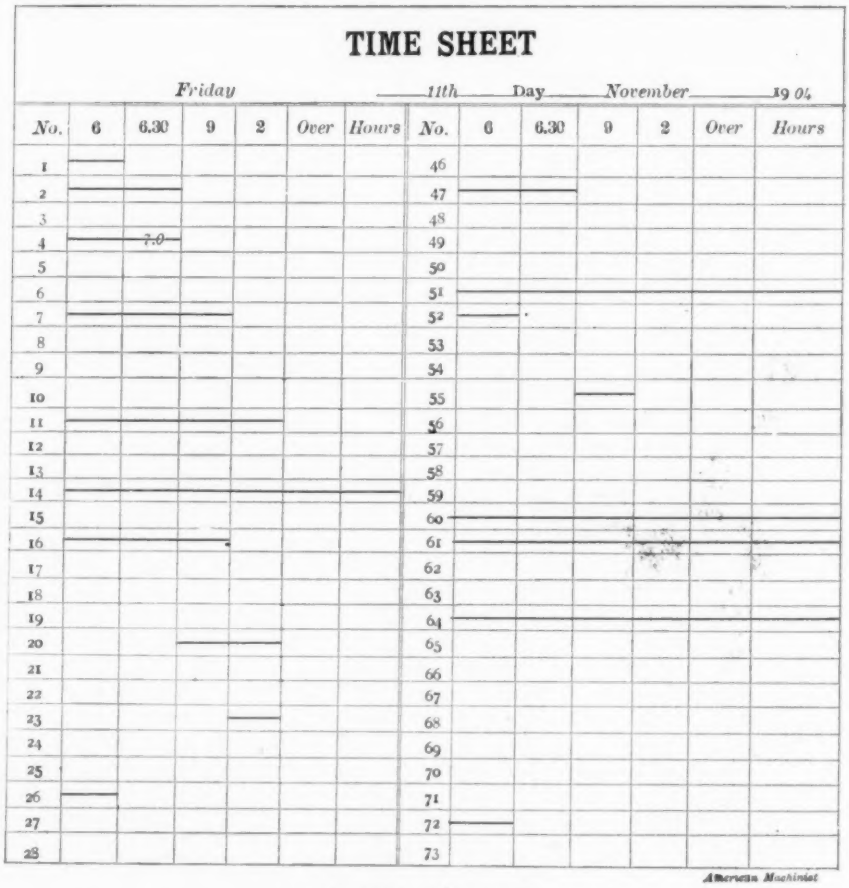
There are 960 artesian wells reported in Queensland, Australia. The deepest is 5,045 feet, nearly a mile, with a daily flow of 70,000 gallons. Another well 4,528 feet deep, gives 1,600,000 gallons at a temperature of 202 degrees Fahr. The aggregate daily flow from all the wells is 385,000,000 gallons.

Graphic Time Sheet.

BY J. WILLIAM CHUBB.

A time sheet on which the attendance of workmen is recorded diagrammatically is in use in the works of Humpage, Jacques & Pedersen, engineers, Ashton Gate, Bristol, England. It is based on the principle that many more workmen come in to work than are locked out; consequently whatever marking is required is to be in regard to the men who are absent or late. It is used in connection with the one check system by which each man on his arrival transfers his check from a board to a suitable receptacle. Of course it is specially suitable for small shops employing up to, say, 100 men. A separate time sheet is used for each day and a portion of a sample sheet is here given, each man having his number as usual.

The vertical columns are headed with the hours at which the men arrive, and with spaces for overtime and for the total number of hours worked. The hours tabulated are those at which the workmen can enter. If the workman is in at the periods tabulated, no record whatever is made on the time sheet. If, however, a man is absent, a line is drawn in pencil by the timekeeper freehand in the space corresponding to the time of absence. For this purpose the timekeeper need only consult the few checks remaining on the board from which they are taken by the workmen on arrival. Thus No. 1 to begin with was out at 6 o'clock, similarly No. 2 was out both at 6 and 6.30, and No. 11 did not reach the works at all during the day of this tabulation. Should a workman be discharged, or certain checks not be in use, the corresponding numbers are ruled thru in ink previously as in the case of Nos. 14, 60, 61 and 64, the regular character of this mark rendering it easily distinguishable from the freehand penciled lines. Moreover, the ruled line extends over all the vertical columns. This would apply in cases where, say, only 70 out of the full list of 90 men were employed. For, obviously, men discharged would not all have the highest numbers; they would probably be spread all over the total, with perhaps most at the end for the newer men. Of course in connection with this time sheet, a master list must be employed having the names of the workmen corresponding with the numbers. Attention may be drawn to No. 4, on which 7 o'clock is written. This exemplifies the case of a pupil who, on condition of attending evening classes, is allowed to commence work in the morning at 7 rather than 6 o'clock. It would apply also to any workman who, for some special reason, was allowed to enter at a special time.



A GRAPHIC TIME SHEET.

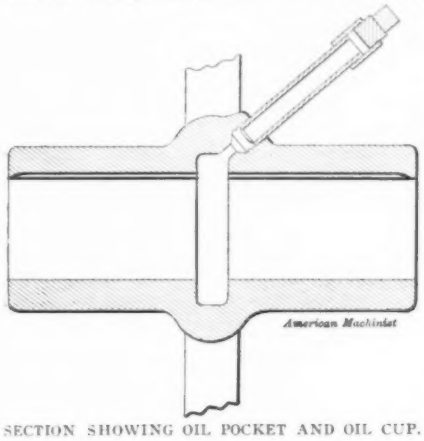
Letters to the Editor.

A Wrong Thing That Works Right Under Some Conditions.

Among the most interesting of the things I have read lately I place "Things that are Usually Wrong." Perhaps I do this partly because I find that Professor Sweet has given some of my own practises a rap over the knuckles, which was even less than some of them deserve.

I have taken heed of some of my ways to the extent of changing my practise where I thought it would pay me to do so, but in his article at page 44 I find one way of doing a thing condemned as being the worst way which is very near to my way, and yet I do not intend to change it. I may at some future time make a change, but it will not be to anything he has shown unless my conditions change.

I refer to his Fig. 39. I understand the difference between Figs. 36 and 39 to be that in the latter the hub of the pulley is made with an oil pocket. While I do not approve of the dimensions of the pocket shown, I judge from the article that any



SECTION SHOWING OIL POCKET AND OIL CUP.

pocket in this place is looked upon as a mistake. It may be such in most cases, but it may well be that things that are wrong under some conditions are not so wrong under others.

After having had experience with a few thousand loose pulleys that have to stand very hard and rough usage, and having tried numerous plans to overcome the troubles which seem by rights to go with loose pulleys, I now make them with an oil cellar as shown in the illustration, and I want that oil cellar narrow and deep. Where the bearing is from 12 to 16 inches long on a 3½-inch shaft it should not be less than ⅝ inch nor more than 1 inch wide, and it can be as deep as it is convenient to go with a tool. This is usually about ½ inch, but more will not do any harm.

For fear that the oil hole may be overlooked I drill down into this pocket with a ⅜-inch drill. I drill partly thru with a larger drill and tap for a ½-inch nipple. On the top of this nipple I screw a coupling, and for a cap for my oil cup I screw in a ½-inch plug. This oil cup never jars off, and if the cap should be mislaid it can always be duplicated, which cannot be said of the ordinary one. A good, big groove to within about ⅜ inch of each end completes the job.

When a lot of oil is poured down thru the pipe and the plug screwed in it either stays in or goes out along the shaft. It does not come out thru the oil cup even if the centrifugal force may throw there all that it will hold. When the pulley stops some of the oil has a chance of falling on the shaft and doing some good, and from the results obtained it evidently does so.

It takes quite a lot of oil to properly lubricate the pulley the first time, as the oil pocket has to be filled up to the lower edge of the shaft before any oil will run out, but the first oiling is generally done by a man from the shop. He knows the construction of the pulleys and does a thorough job. If the oil pocket is not of any benefit it will always stay full and in that case as soon as any fresh oil is put into the oil hole it would run over the pocket and so run along the shaft the same as tho there were no pocket there, and the only harm it could do would be to reduce the bearing on the shaft by the amount of its width.

An examination of one of these pulleys in service that has not been oiled for some time will show that the oil is not nearly up to the bottom of the bore, and as the only place the oil has to get out is along the shaft, it is reasonable to suppose that it went that way in getting out, and did a little good as it went.

There is one positive merit that should be credited to this pocket. If a careless man lets some dirt get in with the oil, or is careless about oiling sufficiently and so leads to dirt on the shaft thru rapid wear the dirt has a chance to lie around without clogging up the oil hole. It takes a lot of dirt to clog up a combination like this one.

The conditions under which these pulleys work are somewhat different from those under which the ordinary ones work. They have to transmit quite a large amount of power at a comparatively slow speed, often 30 horse-power with a 24-inch pulley at 160 revolutions. This means a very tight belt. They are only used as loose pulleys in starting or in case of an emergency, and this means that they are very apt to be neglected, and not get regular oiling. When they are in use they stand still while the shaft runs, and this is very bad for lubrication by any of the ordinary methods.

We tried grease cups but did not have any success with them on this work, altho they work well on crank-pins and other work where it would be supposed the work is much harder. For intermittent work grease is a failure so far as my experience goes. If allowed to stand it hardens and when wanted it will not feed. When it hardens it seems to lose its lubricating qualities also, and helps to make a shaft tight just the same as any other dirt will.

W. OSBORNE.

Mounting Blueprints on Tin.

At page 1646, Vol. 27, J. F. M. gave a description of his method of mounting blueprints on cardboard, which was very good, and I quite agree with him on the economy of doing so. This is the way they are mounted in "our" shop on sheet tin, which I think has some points of superiority over the cardboard, in that it does not warp, the edges do not become frayed, will not break, and occupies a minimum amount of space.

Our standard size sheet which we use almost exclusively for detail work is 13x19 inches, and comes about right for a commercial size sheet of tin 20x28, cut in two, there being no waste of time or material in tinning. These sheets the firm obtain at a local tinsmith's by the hundred all ready cut and with the edges turned over like the sketch in Fig. 1.

The blueprint paper should be preferably of the thinner variety, altho the heavier papers can be mounted satisfactorily in the same manner.

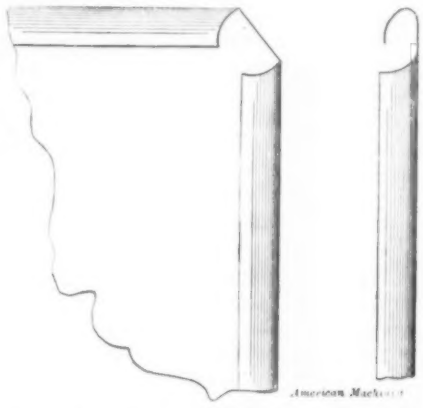


FIG. 1. THE CORNER OF THE TIN SHEET WITH EDGES CURLED.

First trim the print to a size equal to the inside edges of the tin. Then give the back of the print a coat of white shellac, next give the tin an application, followed by a second on the print; immediately place the print on the tin while it is limp, and spread down with a stroke or two of the fleshy part of the hand working from the center toward the edges. Then roll firmly down with a photographer's roller until all wrinkles are out and then let dry. When dried the edges of the tin may be hammered down, using a block of wood 8 or 10 inches long, at the same time leaving as much "curl" as possible, which helps to stiffen the sheet. A coat or two of white shellac may now be given the face of the print, after which it will be ready for the shop. The sheet of tin may have a ⅜-inch hole punched at the upper edge which may be used for hanging it on a nail if desired.

This method may appear rather elaborate, but it does not take a boy long to do a dozen or two. And of course it is used only on blueprints of standard machines.

A. HENRY.

Limit Gages for Bolts and Nuts.

Mr. Kuhlmann's article at page 1576, Vol. 27, under the above heading, bears on a question the importance of which cannot be overestimated, as opinions as to the amount of allowance to make in this work differ with each inspector. What is the proper allowance to make in order to compensate for the changes in lead, diameter and angle of the tap and to permit a reasonable amount of work to be done before the tap loses size?

The smallest allowance I have had to contend with is in the case of a set of gages represented by Figs. 1 and 2; this set consisted of all the standard sizes from ¼ to 1 inch. No. 1 end of Fig. 1 is the standard size on to which the nut must pass freely; No. 2 end is .002 inch large in the angle, and must not enter the nut. This gage is made in three pieces: the central portion *A* is made of hexagon stock with a hole passing thru it, into which are fitted the two threaded ends. These are held in position by the pins *B*, thus enabling either end to be replaced when worn. As the thread is a very sharp V, in order to be positive that the fit is in the angle and not on top of the thread, these gages are small on the outside diameter and a third gage, Fig. 2, is provided which is the same measurement in the angle as No. 1 end of Fig. 1, but is the full size on the outside diameter. There is of course an endless amount of trouble and a needless expense in endeavoring to fit these gages, due partially to the small limit and partially to the very sharp thread. Regarding the V-thread, it is only necessary to say that in all modern shop practise it is abolished and any concern still using this form of thread is incurring a needless expense. As to the .002 limit, it is possible to make taps to work inside of this limit, but the expense is large, a great amount of care is necessary in the tapping, and the life of the tap is very short, while the fit on the gage is closer than is necessary, therefore a .002 inch limit is far too small for commercial purposes.

Some time ago orders were received to make a set of limit gages from ¼ to 1½ inches, similar in style to Fig. 1 but formed with U. S. standard threads, having .003 inch limit, with the outside diameter standard size on both ends; taps were also to be made to correspond, the object being to use these in the tapping of nuts for the trade. Having in mind past experiences with the .002 limit gage, the work was undertaken with much doubt as to the success of the venture. These gages have proved that an allowance of .003 inch makes an excellent fit on all sizes from ¼ to ⅞ inch, but is too close for practical purposes as the slightest variation in the taps ruins the fit. In almost all classes of tools it is possible to grind to the proper measurement after hardening, but in tap making this is not practical, therefore an allowance must be made to overcome the imperfections. In the hardening of taps the lead invariably shortens; the amount of shrinkage varies with different makes of steel; a fair estimate is from .0005 to .0015 per inch. If the gage enters the nut from either end but will pass only part way thru, the lead of the tap and gage differ. The hardening also causes the tap to expand in the angle of the thread. There is considerable difference in the amount of

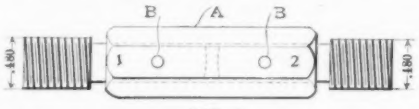


FIG. 1

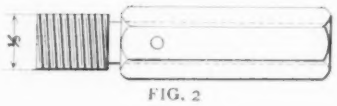


FIG. 2

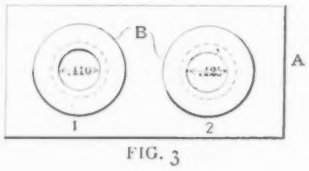


FIG. 3

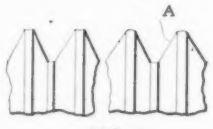


FIG. 4

American Machinist

LIMIT GAGES FOR BOLTS AND NUTS.

expansion in the various sizes. On consulting the table it will be seen that the expansion of the ¾-inch and ⅞-inch taps exceeds that of the other sizes. This is due largely to the difference in form after milling. A deep-fluted tap with a narrow section will expand more than one with a wide section and a small flute. In fitting the gages with a .002 limit it was found necessary to have the lands very wide and grind to the proper width after hardening. As the tap expands in the angle, it of course changes the angle slightly and for this reason it is necessary to make the holes in the nuts of equal size if uniformity in tapping is desired.

A	B	C	D	A	B	C	D
⅛	.001	.002	.004	⅝	.001	.003	.006
3/16	.001	.002	.004	¾	.0005	.003	.006
¼	.001	.002	.005	⅞	.0005	.003	.006
5/16	.001	.002	.005	1	.001	.003	.006
⅜	.001	.002	005	1⅛	.0015	.0035	.007
7/16	.001	.002	.005	1¼	.0025	.004	.007
½	.001	.0025	.0055	1⅜	.003	.004	.007
9/16	.001	.0025	.0055	1½	.003	.004	.007

A = diameter of nut.
B = amount by which tap is larger than standard gage when measured in angle *before* hardening.
C = amount by which tap is larger than standard gage when measured in angle *after* hardening.
D = amount by which maximum gage should exceed standard gage when measured in angle; must not enter nut.

TABLE OF NUT TAP AND GAGE ALLOWANCES.

With the Pratt & Whitney standard reference gages as a basis, I have collected the data given in the table, which insures a good fit. The taps are cut with a perfect lead screw, therefore the lead is about .0015 inch short after hardening. The gage limits here submitted are derived from a careful measurement of an output of several hundred thousand nuts daily, no limit gage being used. In some instances the fit is slightly closer than the limit here specified, but the taps will thread only a few thousand nuts before losing their size, which greatly increases the tap expense. The only opportunity presented to secure information as to what the trade would not accept was in connection with some ⅝ nuts which were a perfect fit on a gage .007 inch large in the angle.

The limit (maximum) gage should be made standard size on top of the thread, as a properly made bolt will never be oversize on the outside diameter. The tap should be made from .006 to .007 inch above the standard, as the wear on top of the thread as at *A*, Fig. 4, is very noticeable; this also allows the nut and bolt to fit properly in the angle.

Regarding the gage for bolts, Fig. 3 represents a gage which produces accurate work. The plate *A* has two reamed holes into which are fitted the tapped collars *B*; these collars are of equal size in the angle of the thread, No. 1 having the same size hole as that in the nut, while No. 2 hole is several thousandths larger, the object of the latter hole being to determine whether the fit is in the angle or on the bottom of the thread. After the point of the thread of the die wears enough to prevent the bolt entering the nut, the point of contact being the bottom of the thread the bolt will not enter No. 1 gage. In adjusting the dies the bolt is always tried in both gages. Should it fit No. 2 but refuse to enter No. 1, it is evident that the dies need grinding. Without No. 2 gage a careless or poor workman will often close his dies when the fault is with the bottom of the thread and a lot of bolts small in the angle will be the consequence. All bolt gages should be of the same thickness as a standard nut of equal size.

In the making of these gages it is necessary to discard a large percentage on account of the changes in size in hardening, there being no adjustment, and of course they must be condemned after the slightest wear. The gage presented with Mr. Kuhlmann's article is superior in every way. The sealing wax which prevents any alteration of the size is a very good idea. While No. 2 gage in Fig. 3 will be found to be very useful, it is not necessary if good workmen are employed.

In the manufacture of any article for the trade at large there must be a limit of perfection, a well-defined limit which must not be departed from under any condition. This limit must allow the article to be manufactured at a reasonable profit, and must give the intelligent customer satisfaction. With such a limit established, the

customer desiring work so near perfection as to materially affect the profits, should be charged accordingly or allowed to depart to the competitor who is willing to operate his works on a no-profit basis. The manager, superintendent or foreman who insists on absolute perfection is likely to find himself in as much trouble as the "good enough" man. ALLAN WINTER.

Automobile Steering-Lever Angles.

Automobile manufacturers at first followed the "horseless carriage" idea too literally, but we now find an infinite variety of constructions throughout, except in the device for automatically changing the angle of the front wheels relative to each other, in rounding a curve.

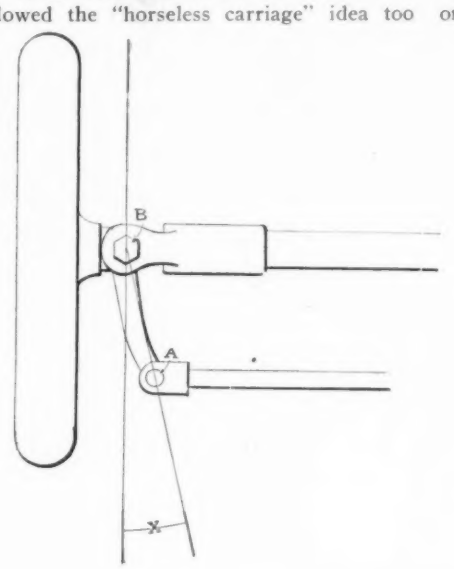


FIG. 1. AUTOMOBILE STEERING LEVER.

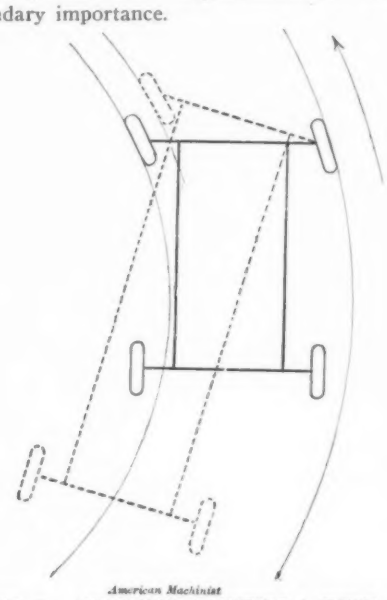


FIG. 2. AUTOMOBILE ROUNDING A CURVE.

I inquired of the superintendent of an automobile factory of considerable magnitude as to how the angle *X*, Fig. 1, was found. He had found, after a large amount of laying out on the floor with chalk lines, that point *A* should lie in the line connecting *B* with the center of the rear axle regardless of the length of wheel base, and if the arms were to lead ahead instead of backward from the front axle, the same rule would hold true. How this conclusion was arrived at he omitted to state, but it is obviously incorrect.

The rear wheels will describe smaller circles than the front, as shown in Fig. 2, and as the length of wheel base is increased, the diameter of the rear wheel circles will be correspondingly decreased, as shown by the dotted lines of Fig. 2, which necessitates a greater angle formed by the front wheels, and therefore an increase of the angle *X* of Fig. 1. The method of procedure described above would produce the opposite effect.

This gentleman also explained that in several instances, when a few extra large, stock forgings of the kind having the arms projecting ahead were bought from outside parties, they were found to have so great an angle that they interfered with the spokes. The arms were accordingly bent in from the wheels, and this alteration did not make any material difference in the steering of the car. When this order for forgings was filled no questions were asked as to the length of the wheel base.

From these facts I gather that the angle to which the arms are set is only an approximation to what is desired, the angle *X* varying among automobiles having equal treads and wheel bases, even those of the same make being considered of secondary importance.

Now that the price of tires is so high, and still advancing, if there is an accurate solution of this question, even should it involve discarding the present simple device entirely, it seems as tho an extra expense here would be more than counterbalanced by the extension of the life of the tires, tho presumably any extra wear of tires occasioned by the present device would not be comparable with that caused by the skidding incidental to the fast taking of curves. If this angle is to be only an approximation, it should be as close as possible.

Anyone enlightening us on this point might incidentally tell us how to find the diameters of circles described by the rear wheels, given the wheel base, tread and diameter of one of the front wheel circles.

In this case I have assumed that the automobile continues in a circle, which of course would rarely be the case in practise, and have not considered the position of the car when turning from a straight course nor when taking a reverse curve.

AMA.

What Should He Have Paid ?

At page 89 you have a gas engine problem to which I give a solution. In solving this problem we are to assume that the load conditions when running are the same as specified in the guarantee and we should also assign some commercial life to the engine. Assuming this to be ten years, the actual increase in fuel cost to the buyer over that guaranteed would be, during this period, $2,760, and it is evident that to this amount he would be justly entitled. In addition to this, the money spent on excessive fuel consumption would have an earning capacity of about 5 per cent., which would amount to about $760 in ten years. The total cost to him, then, on account of his inefficient engine would be $3,520. Under these conditions there is only one of two things he could do, *i. e.*, tell the manufacturer to take out his engine and pay him for the expenses entailed on account of its erection, which should include the reinstallation of the steam plant, or the manufacturer should pay him $1,920, which is $3,520 less $1,600, the contract price of the gas engine.

G. F. MADDOCK.

Pattern for a Window Sill With Spurs.

Fig. 1 is a sectional view of a window sill which is 12 feet 8 inches long, and has spurs ½ inch high on the top surface of the plate. To turn these and put them on the sill would be quite an expense. We made a board (see Fig. 2) 14 inches long, which was the width of the sill, 8 inches wide and 1 inch thick, tongued and grooved the end of board as shown, so that there would not be any danger of it curling or warping; bored ½-inch holes in the board 1¼ inches apart; turned a plug as Fig. 4. After the sill pattern was drawn from the mold, we placed the board in the nowel and punched the plug in the sand as shown in Fig. 5. By this method the sill casting was made very clear and sharp. Fig. 6 is a sectional view of the sill pattern.

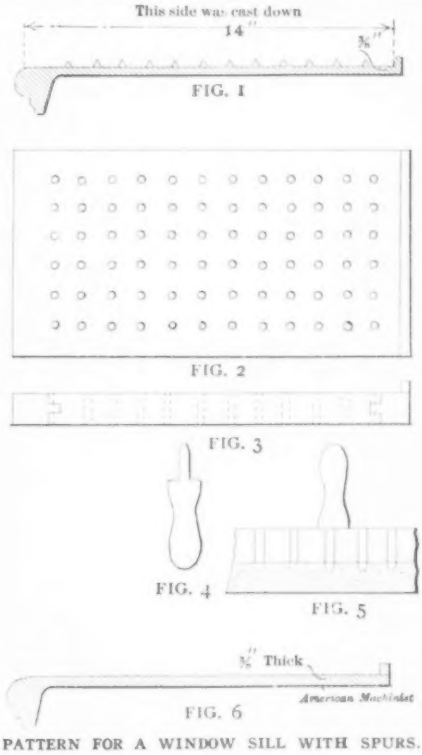


FIG. 1

FIG. 2

FIG. 3

FIG. 4

FIG. 5

FIG. 6

PATTERN FOR A WINDOW SILL WITH SPURS.

JOHN F. PITZ.

Cutting an Angular Opening in a 30-Inch Water Pipe Under Pressure.

The Snow Steam Pump Works, Buffalo, N. Y., a branch of the International Steam Pump Company, of New York, is at present installing a 10,000,000-gallon horizontal cross-compound pumping engine for the city of Auburn, N. Y. It was proposed that the new suction line to this engine be connected by cutting into the existing line. Several specialists, who make it a business, and have special machinery for tapping water mains under pressure, were invited to bid on this connection, but declined, owing to the angularity and depth of cut.

The pipe *K* is built of sheet steel, with circumferential and longitudinal riveted seams. The accompanying drawing and photographs illustrate the tool and method gotten up by the Snow Company, which successfully made the cut and met all necessary requirements for the new suction pipe connection.

After the joints in the special fitting were made, a 30-inch gate valve *L* and a short section of new suction pipe *M* were attached, with their respective joints made thoroughly, as this much was to be the beginning of the new suction line.

The branch of the special fitting *G* and the short section of the new suction line *M* were machined in advance to receive a milling device designed especially to cut the opening necessary for the new suction line. The short section of the new suction pipe *M* was prepared for the outboard rotating head, and as a receptacle for the internal parts of the milling apparatus, when withdrawn after the cut had been made.

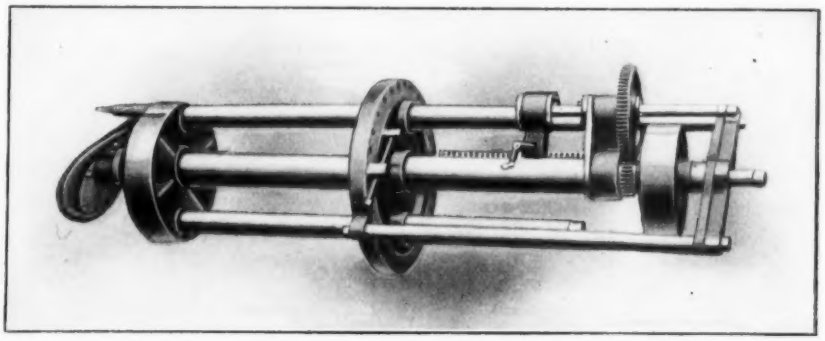


FIG. 3. MILLING DEVICE SHOWING DRIVING AND FEED MECHANISM.

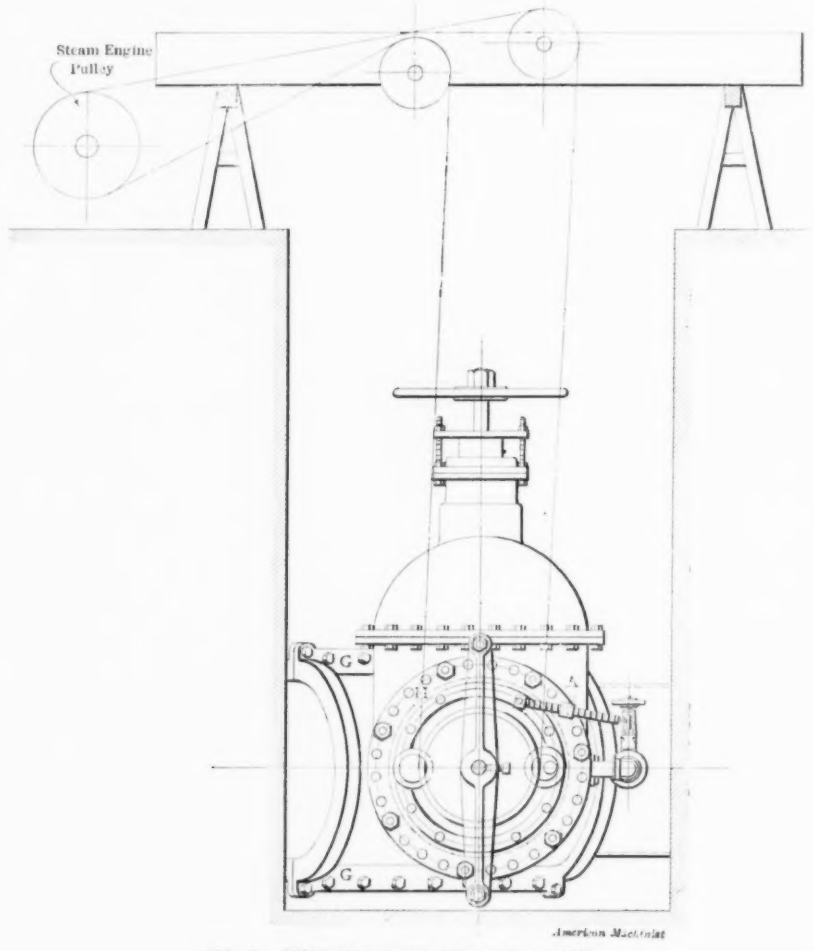


FIG. 1. SHOWING DRIVE AND FEED SCREW.

In order to make the suction pipe connection, a suitable coffer dam was built, exposing a portion of the pipe, which is about 4 feet below the lake level at this point. A special fitting *G*, made in two parts, was assembled over the suction pipe, having the branch of the special fitting *F* centralized with a previously attached portion of the milling device.

The closing of the gate *L* and removing of milling rig at this stage of the operation complete the tapping of the old line.

The milling device consists of a head carrying a combined drill and milling cutter, and mechanism for driving both the head and the cutter. The cutter head is attached to suitable mechanism for advancing it to the work or withdrawing it into the short section of new suction line, so that the gate valve may be shut and the device removed when the job is finished.

All external moving parts are provided with stuffing boxes and water-tight joints to reduce leakage as much as possible during the process of making the opening in the old line while under pressure, and without interfering with present pumping machinery drawing their supply thru this line.

The supporting bar for carrying the combined drill and milling cutter is provided with rack and pinion *E* to follow the path of the cut, which was previously traced and registered on the front head as a guidance for the operator in regulating the position of the cutter. The combined drill and milling cutter *D* is actuated thru a train of gears *J C* from the pulley *B* and fed with an interrupted radial feed *A* with a pin and screw arrangement in the front head. The nut of the feed *A* is moved from hole to hole in the head *H* as convenience demands.

GAFFER.

The Accident to the "St. Louis."

I have read with interest the remarks of X. Y. Ezee, C. H. J. and Amos Price, at page 57, upon the above subject. Referring particularly to the methods of tightening up bottom end bolts, I am inclined to agree with the opinions of the two former, as they are the results of their experiences, whereas Mr. Price's design is merely in the "proposed" stage, according to his belief, which of course is contradicted by C. H. J.'s experience of a bottom end of identical design. Mr. Price claims that a bottom end of his design will run with a minimum quantity of oil and only a few degrees warmer than the surrounding atmosphere, but does not state why it will give these very desirable results; and I do not see wherein it differs from the common marine type bottom end

in any respect which would cause it in practise to attain them. With regard to the wedge pieces, there is no necessity for the excessive inclination which they have and I would humbly suggest that it be reduced about 30 per cent., as that would give sufficient to wear the bronze or babbitt flush with the cap and rod, and also reduce the tendency to jar loose, referred to by C. H. J. The objection may be urged to this, that the wedges would have more travel horizontally for a given difference in hight and also that there would not be sufficient surface then on the liner, but the advantages would, in my opinion, more than compensate for the disadvantages. I would also slot the hooks on the rods with the same object in view. If Mr. Price would be good enough to give a detailed account of the method and operation of adjusting this bottom end—say, with pin 20 inches diameter—I might be able to see some good points about it to which at present I am blind. I blushed for our branch of the profession, when I read his scathing comments upon the use of salt water as a lubricant by marine engineers referred to by one of POWER's correspondents, Vol. 24, page 667, and forthwith referred to my copy for verification of his statement. I take it that the remark referred to is "The guides have water running around or thru them, as the case may be—in fact, most engines won't run well without it." Now, I understand that this remark referred to the guides only, and if so the statement agrees with my experience. There are several reasons for this, in the usual form of marine engines fitted in ocean vessels—I refer to the inverted type. First, owing to the cylinders resting on top of the columns, upon which the guides are bolted, the heated air lodges underneath the cylinders, and keeps the guides very warm. Second, the engines are surrounded by bulkheads and bunker casings as closely as possible, which also tends to retain the hot air underneath the cylinders and around the engines. Third, the connecting rods are usually much shorter in proportion to the throw of the crank in marine engines than in stationary ones and a greater stress is thereby thrown on the guides in marine engines in proportion to the work done. Fourth, the surface of the guide shoes is often too small.

Mr. Price can decide whether the engine builders should be held responsible for the two latter conditions or not. If there are no means of cooling the guides, they will ultimately attain a temperature so high that dependence on our sense of touch has to be abandoned and we have to depend upon our sense of smell. For instance, we have some of our engines running in a temperature ranging from 140 to 170 degrees Fahr., a temperature too high for the sense of touch to inform us or warn us when the part is rising in temperature until it has risen too far. Again, owing to the confined spaces and compact design of marine propelling engines, it is difficult to locate speedily the source of the odor arising from a part which is running rather warm. In such cases we must simply ease the speed and give the engines extra oil and plenty of it—oil is relatively cheap—relatively, that is, to the cost of rebabbitting, delaying the ship, scaring passengers and injuring the liner's reputation for punctuality. On such occasions a water service is handy and should be used upon such occasions only, with the exception of that thru the *hollow* guides for reasons stated before.

I am in accord with Mr. Price in his statement that it does not make any difference to an engine whether it twists a screw or armature *when* the ship is in smooth water, the foundations stable, no change made in the loading of the ship—and consequent alinement of shafting—operating in as low a temperature and as spacious an engine-room as those ashore. Those are ideal conditions never realized in practise afloat, and the actual conditions under which a marine engine works differ so much from the above and militate so strongly against their ideal operation that it surprises one that they work as well as they do.

Mr. Price suggests that it is time to put some land engineers afloat who know how

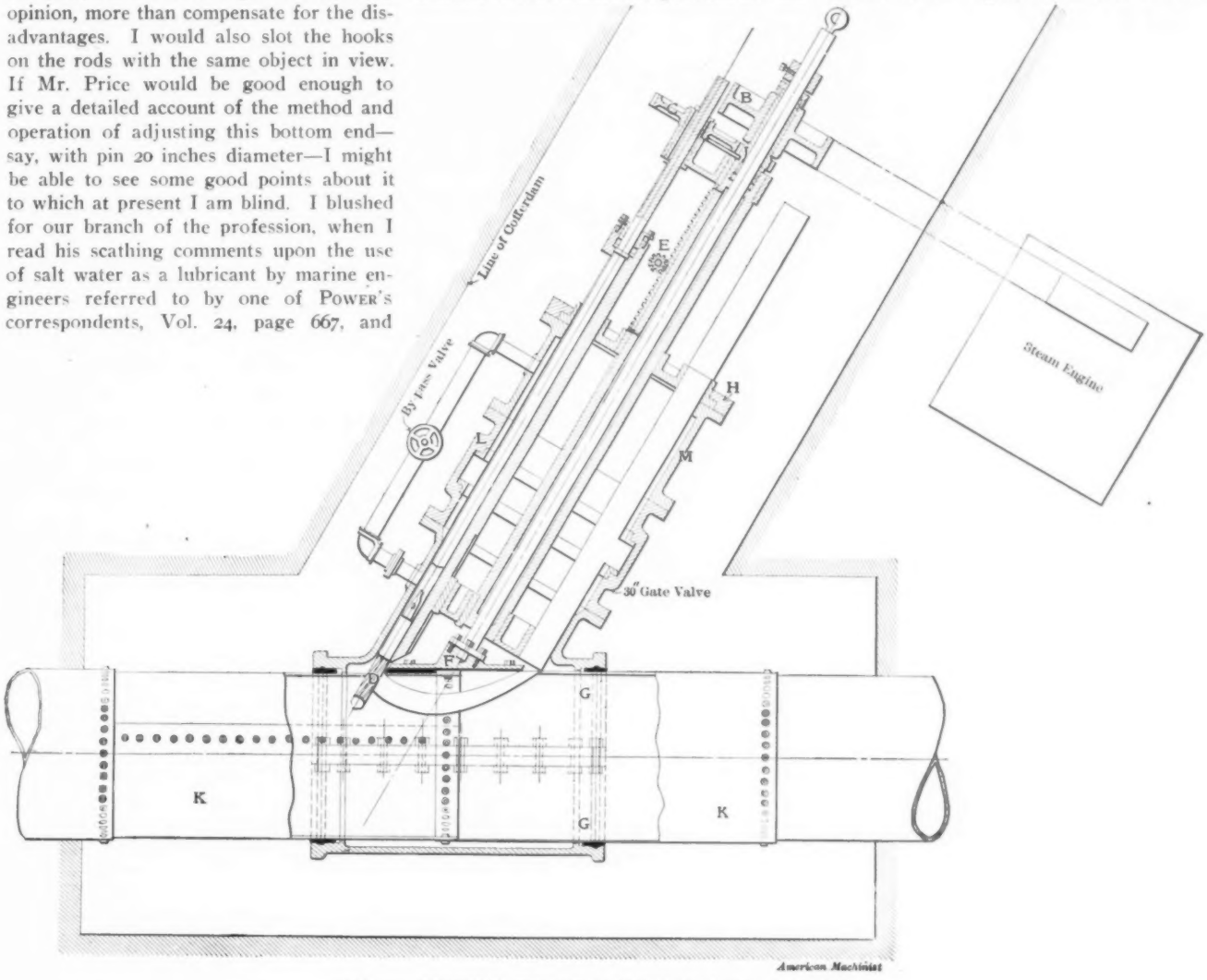


FIG. 2. SECTIONAL VIEW OF MILLING DEVICE IN POSITION.

to oil and adjust engines. When I read this first, I thought it was intended for sarcasm, but after reading the remainder of his article I came to the conclusion that it was suggested in all seriousness. For his information I might tell of various experts on land oiling who honored our line with their suggestions and experience, produced beautifully printed and illustrated books of testimonials showing the benefit derived from the adoption of their suggestions, systems, cups, oils and compounds ashore, but altho we did our best to attain like results we were unsuccessful. I could give him several instances from my personal experience, but, as Kipling says, "that is another story."

We have certainly to give closer personal attention to our machinery, lead a more strenuous life and exist under much less pleasant conditions than our brethren ashore—I have this on the testimony of several ex-seagoing engineers. One has only to inquire to find the large proportion of such men who are in charge of some of the largest power stations in the world to-day to be convinced that the marine engineer is quite capable of holding the highest places in the profession, and I could name at least one very large plant where the engines ran more satisfactorily after the marine engineers took charge, and in consequence of a knowledge of the foregoing facts I do not think that Mr. Price's suggestion would justify its adoption. We all know that there are engineers and engineers. I have worked in the shops and assisted in important capacities in the specification, design, construction and operation of large marine engines—but am still willing to take, and will gratefully consider, any suggestions from Mr. Price or anyone else thru which I may be able to expedite work or reduce operating expenses. All our staff are trained mechanics and have had a technical training in the evening classes of various technical colleges. I am afraid that Mr. Price is one of those people who imagine that those who go to sea are quite an inferior body intellectually, and if so, I beg to assert that he is laboring under a mistaken impression which is only too prevalent and causes the loss of thousands of dollars annually to the firms who have managers harboring the same delusion. From such sources emanate imperative orders to those on board to experiment with impracticable ideas which only raise the operating expenses, while the opinions of the engineers on board are accorded a patronizing toleration which aptly illustrates the old idea that "a prophet has no honor in his own country" and might be modernized into "an engineer has no honor in his own company."

At some future time I may give Mr. Price a true account of the life of a seagoing engineer which will open his eyes to the actual conditions under which men and machinery work at sea. In conclusion, I would suggest that it would be mutually beneficial if Mr. Price would refrain from such an absurdity as to propose sending shore engineers to instruct those on board ship. In fact, I think that if Mr. Price were to put in some time on shipboard he would find that he had come as student, not as instructor, and would return to shore life with increased respect for those who go down to the sea in ships. He might find a critic "worthy of his steel" (among those in active service) whose profession often forbids his timely appearance in the columns of the AMERICAN MACHINIST—and who is proud to be, like the subscriber,

A MARINE ENGINEER.

Expanding Plug for Cutter Grinding.

At page 1481, Vol. 27, Geo. J. Huitink shows an arbor or stud with a taper end on which he places a bushing with four cuts in it extending nearly but not quite to one end which is left closed or solid. I fail to see how the bushing is going to expand, as the sketch shows the closed or solid end to be a fit on the taper. If

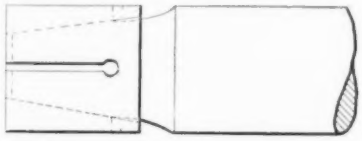


FIG. 1

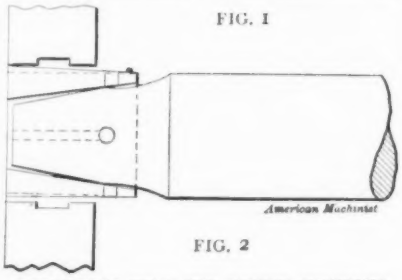


FIG. 2

EXPANDING PLUG FOR CUTTER GRINDING.

the stud or bushing had been relieved as shown by Fig. 1, it would be possible to expand the cut end of the bushing; even then the bushing would be very apt to fit the hole in the cutter, as shown in Fig. 2. Notice the cutter has a bearing only on the edge of the hole, and as no flange is shown to keep the cutter from wabbling it will quite likely run out sideways and if ground in that position and then placed on an arbor it will in all probability cut first on one side for one-half of the revolution and on the other side during the other half of the revolution. With the plug and bushing made as shown in Fig. 1 and the bushing driven on the outer end will spread open after the manner of a spring chuck and, as shown in Fig. 2, will have no bearing at the outer end, which is just under the cutter support, and what will happen can only be guessed at.

Long ago I decided the best way was to have the holes in the cutters of one size even if they had to be lapped or ground to size. Even then the cutters when ground and replaced on the milling machine arbor and a good fit at that did not seem to cut all around, or in fact any better than a cutter with a large hole and no pains taken to do an extra good job of grinding.

Not very long ago a representative of one of the leading milling machine makers told me that his concern had tried all kinds of schemes to grind cutters and have them run true, and grinding them on the arbor seemed to give the best results, but even then they could take any common ground cutter and place it upon the arbor with almost an even chance that it would run as good or better, and the special grinding on the arbor scheme was for the most part abandoned; and this man was in charge of one of the departments and a first-class mechanic.

For my part three collars with a variation of 0.002 inch, if necessary, will cover any reasonable range of over-size holes in the cutters. G. SCHNEIDER.

[In the sketch referred to by Mr. Schneider, the end view of the bushing shows two slots dotted in, indicating that these slots are cut from the rear end, thus in connection with the other slots milled from the front, allowing the bushing to expand from both ends.—Ed.]

Talking to Machinery.

I notice that Mr. Osborne has, at page 95, an article, interesting as usual, about asking questions of recalcitrant machinery and, by applying common sense in receiving and interpreting the answers, doing away with the necessity of "doctor bills" for every wheeze or cough that may be in evidence. Now, I don't believe that he intends this to apply to electrical machinery, for it almost invariably answers with such a snort when talked to at random that there is rarely any use of receiving the answer as far as the questioned machine is concerned; but, if a fellow is not so scared that he forgets what he did, it comes in handy to remember never to put that identical question to another machine. I once knew of a case in which a gas engine objected strongly to some very personal questions. The owner of this engine was so fond of holding communion with his machinery that it had reached the point where it could be properly termed meddling, and he decided one day to have a heart to heart talk with his engine. To facilitate matters he removed the cylinder head, but failed to completely shut off the gas, and upon the introduction of a torch the engine simply roared. Possibly this was gas-engine laughter, but the Old Man took it seriously and installed an electric motor to do the work, and, strange to say, it was only a short time before he (evidently intending to hold a midnight conversation) placed a lantern on top of the motor connections which caused a short circuit that rendered the motor speechless. As a general warning I would suggest that before asking questions of machinery the language of the individual machine be thoroughly studied, and that close attention be first given to all that the machine

has to say voluntarily, and when the questioner is ready let him first ask the question mentally, and if the answer is satisfactory then speak out loud to the machine, and even then if possible stand where he is not liable to be hit. J. E. TERMAN.

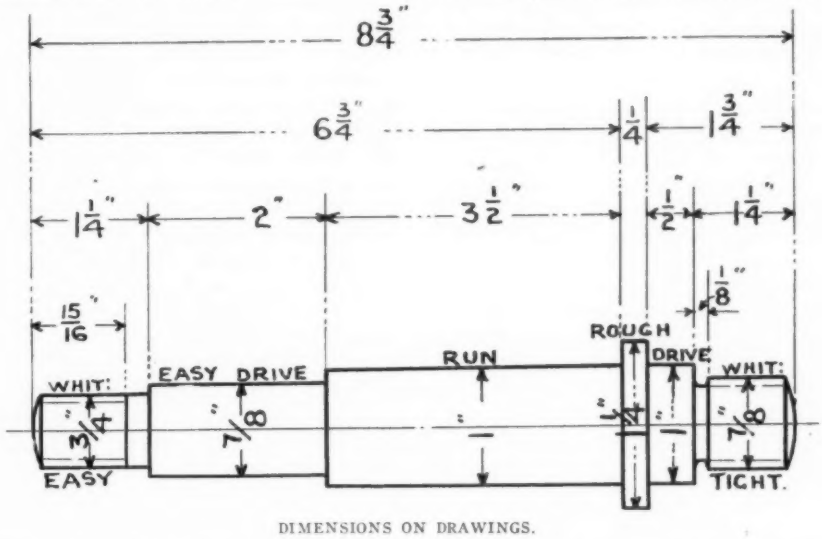
Dimensions on Drawings.

Referring to the method of dimensioning drawings given at page 1570, Vol. 27, by E. H. Fish, and at page 1707 by "Sutram," the particular piece in question being a stud, it appears to me that the whole question depends more upon shop system than anything else.

We will take Mr. Fish's method first: It is necessary for the man in the shop to understand that the allowance made for fits as given on his sketch need not be absolutely adhered to. Probably the man knows that he can work within, say, .0005 inch of that allowance, but not exceed it, or, on other hand, that he can use that allowance ± .00025 inch. If such is the case, then well and good. That is one system.

Now "Sutram," while improving on Mr. Fish's method of dimensioning the stud lengthwise, makes it of far less value when figuring the diameters, as he relies on the foreman to put his man right as to what allowance should be made for fits.

That is not the best practise by a long way, as what will the foreman do if he cannot get hold of the drawing or other parts showing how the stud is to be fitted in position? We cannot tell what allowance is required any more than can the workman. For small jobbing shops that arrangement might do, but when time is valuable and "output" considerable, other methods must be devised.



DIMENSIONS ON DRAWINGS.

Where interchangeability is worked for and tools are periodically examined and kept within standard limits, it is only necessary for the draftsman to mark the various diameters on his drawing, as "running" or "easy drive," "push," or "driving fits," as the case may be. For nearly all cases these notations suffice to cover the range of accuracy required.

Where this system is prevalent, the turner will know exactly what limits to work to, or how much to leave on if the piece is to be ground. The holes will be reamed to standard limit gages to receive the stud, and the parts will be ready for assembling without undue waste of time in any way.

Where the work is of a more exacting nature, the draftsman should, of course, dimension his drawing accordingly, but for ordinary work this system will be found consistent with good shop practise.

I enclose sketch showing how I should figure up that stud.

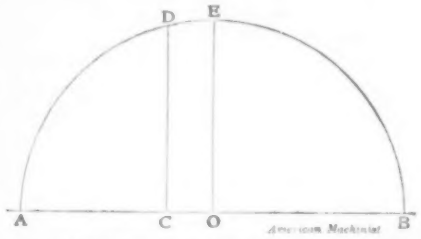
In marking one thread "tight" and the other "free" Mr. Fish is quite correct, as it is a simple matter to size the thread to suit the tapped hole, especially if a sizing machine is employed. This is another point in shop system. S. H. G.

Coventry, England.

The Factoring Method of Extracting Roots.

The communication of Mr. Ernest McCullough, at page 83, calls attention to a method of extracting roots, which, altho fully described more than fifty years ago, is by no means used as much as its merits warrant. So far as I can ascertain, the method which is fully and very clearly described by Mr. McCullough, was original with Professor H. N. Robinson, a mathematician of the first half of the nineteenth century, a teacher of mathematics in the United States Navy, and author of a series of mathematical text books; and the earliest mention which I have seen of it is in a very interesting book forming a sort of sequel to these text books, and called "Mathematical Operations." This was published in New York, my copy bearing the date 1854, and I believe that it is now altogether out of print.

Briefly, the method consists in considering the operation of extracting roots as a particular form of factoring, the given number being separated into two, three or more *equal* factors, by the simple operation of assuming a trial factor as close to the true one as can be ascertained by observation, and then taking the arithmetical mean of the several *nearly equal* factors thus found. The result may be obtained as nearly correct as is desired by repeating the work, using the first result as the trial factor the second time, and so on.



THE GEOMETRICAL MEANING OF THE FACTORING METHOD OF EXTRACTING ROOTS.

It is interesting to compare the geometrical significance of this operation with the arithmetical one, and for this purpose the extraction of the square root may be considered.

Suppose we separate the given number into two factors which are nearly equal, this being done simply by assuming one factor and obtaining the other by simple division. Referring to the figure:

Let AC be one factor.

Let CB be the other factor.

On AB as a diameter describe a semicircle, and let OE be the radius of the semi-circle, then this radius OE will be the first approximate root obtained by the factoring method.

But the true square root of the product of the two factors is CD, because the perpendicular erected in a semicircle is a geometrical mean between the two parts into which it divides the base, *i. e.*:

$$AC : DC :: DC : CB$$

or $$DC^2 = AC \times CB$$

and $$DC = \sqrt{AC \times CB}$$

It is apparent from an examination of the diagram that DC can never be greater than OE, and when the two factors are equal their half-sum OE will be the true root. It follows that the half-sum of two nearly equal factors will *always be a little greater than the true square root* of their product; but, as will be seen by the diagram, the difference between the true root and the half-sum of two factors is very small, even when there is a considerable difference between the two factors.

A useful application of the method is in obtaining the square or cube root of a quantity consisting of a whole number and a decimal, in connection with the tables of roots and powers to be found in any of the engineering handbooks.

Thus, suppose the square root of 1513.4276 is desired. It is only necessary to take out from the tables the square root of 1513, divide this into 1513.4276, and take the half-sum of the two factors to obtain the root desired.

By reference to Barlow's Tables, for

example, we find the square root of 1513 to be 38.8973006. We then have:

$$\frac{1513\ 4276}{38.8973006} = 38.9082938$$

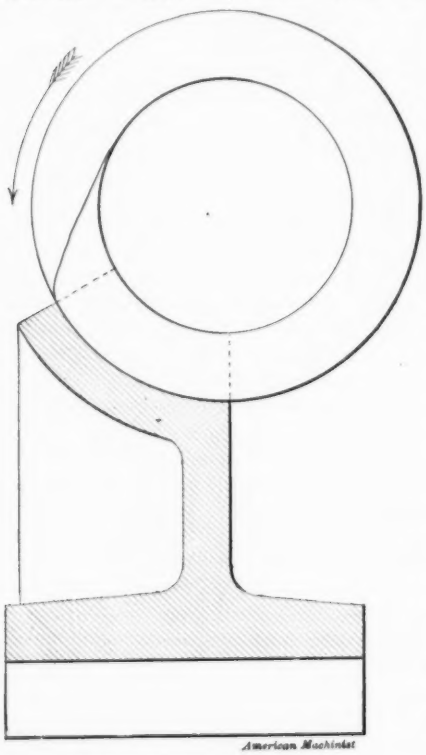
and $$\frac{38.8973006 + 38.9082938}{2} = 38.9027972$$

which is the root correct at least to the fifth decimal place.

The usefulness of the method led me to insert it in my translation of Lübsen's "Arithmetic and Algebra," altho it was not in the original German, I having first met it in the work of Prof. H. N. Robinson, noted above. H. H. SUPLEE.

The Easy Cast Worm Gear.

Ernest J. Lees' suggestion at page 91, present volume, to get additional wearing surface on the worm gear made as I described at page 1670, Vol. 27, is all



THE EASY CAST WORM GEAR.

right; but, as he suggested, the room taken up and the extra expense would be against it in our case. We find that it will do more than three times the work that the one made by our former method would do. As for side thrust, I will say that there is less than with an ordinary worm gear by running the worm as per sketch. If it is imperative to rotate the worm in the other direction, the wheel may be placed on the other side.

Syracuse, N. Y. FRED GINKEL.

The British Admiralty has prescribed as clearances in bearings of battleship engines not over .030 inch for main bearings, .020 inch in crossheads, and .025 inch in crankheads. For lighter work smaller allowances are to be made.—*Mechanical Engineer*, London.

Epochs in Marine Engineering.*

THE PADDLE WHEEL.

The first marine engineering, in the modern sense, was the adaptation of the steam engine as already in familiar use on shore to a modification of the centuries old method of propulsion, the oar. I believe some attempts were actually made to adapt the steam engine to a series of oars, which would have meant something like a mechanical trireme; but of course the trained mechanical sense soon saw that the collection of the oars in a revolving wheel was the correct solution. It is interesting to remark that practically about the same time that the side-wheels were used on the seaboard the first marine engines were the shore engines modified to suit the circumstances, and thus on the seaboard the engine was designed and worked with what we now consider an exceedingly low pressure. On the Western rivers, where the change had been made in the location of the wheel, there was also the additional change of dispensing with the condenser and using very much higher pressures. It was doubtless due to this fact, that the first non-condensing engines really carried a very high pressure, that the term "high pressure" in the early days meant non-condensing. The reason for the difference is of course very clear: the Western rivers are very shallow and it was necessary to make the machinery as light as possible; on the seaboard and the rivers of that section there was deep water, and the vessels had displacement enough to permit heavy machinery.

Ordinarily the history of this olden time could have only an antiquarian interest for us, but we are unusually fortunate in still having with us in the active practise of his profession an engineer who saw the first commercially successful steamboat, the "Clermont," so that thru our "grand old man of engineering," Mr. Charles H. Haswell, we still have a living connection with that earlier time. One of my former assistants some years ago contributed a series of articles to one of the engineering magazines and has given some data as to the performance of the "Fulton," the first American steam man-of-war, whose machinery was designed by Mr. Haswell, who was also her first chief engineer. An extract from the "Fulton's" steam log for January, 1838, shows that the maximum steam pressure was 11 pounds, the vacuum 24 inches and the maximum revolutions per minute 18.

THE SCREW PROPELLER.

About 1836 the screw propeller was brought forward for driving large vessels. This date is prior to that of the building of the "Fulton," but naturally, in the first steam war vessel, it was not considered desirable to do anything of an experimental nature. The reason for the change is easy to see. On a long ocean voyage the change in displacement is due almost entirely to the consumption of fuel. In the case of the propeller this makes practically no difference, while in the case of the paddle wheel the immersion of the floats is changed, with a diminution of efficiency. Further than this, the paddle boxed offered very great resistance to strong head winds and also brought severe stresses on the ship, due to rolling in heavy seas, the propeller not being affected by either of these last two causes. To-day, for work in deep water, the screw of course is the only propeller; but for river work, particularly in shallow rivers, the paddle wheel is still used.

Probably fully as much has been done to improve the design of propellers as of any other part of marine machinery. In the early days the rules for propeller design were exceedingly crude. As engine speeds increased, however, it was seen that the old rules were utterly inadmissible. Probably one of the great troubles with screw propeller design at the beginning was the mistake made in considering the action of the screw as analogous to that of a bolt working in a nut, from which it was inferred that the smaller the slip the greater the efficiency. As a matter of fact, a screw propeller is really a pump for driving a mass of water astern. When this had once been realized, it was seen that there must be a certain amount of slip and that under proper conditions there could be a relatively large slip and still high efficiency.

Multiple screws were used as early as our Civil War on some vessels known as "tin-clads" on the Mississippi. Twin screws were first used in war vessels where the necessity for keeping the machinery below the deck would not allow of all the power being conveniently used on a single shaft, but the great advantage of security against total disablement and for maneuvering soon made them the rule for all naval vessels large enough to admit of them. They were much longer in coming in the merchant service where the same limitations do not obtain.

In the navies of France and Germany the triple screws have been used to a considerable extent, and I used them myself in our own fast cruisers "Columbia" and "Minneapolis." My own belief is that they have decided merit for vessels using above 10,000 horse-power. This view, however, was not shared by my Board colleagues in the Navy Department, so that their marked success in the two vessels named was not allowed to be repeated in later design. With the advent of the steam turbine, multiple screws have again come to the front, this time on account of the extremely high speed of rotation of the shafts. Before leaving the propeller, I may mention, in connection with the improvements in its design, the care that is now taken to avoid needless friction by making

*Abstract of an address by George W. Melville, Rear Admiral, United States Navy, at the monthly meeting of the American Society of Mechanical Engineers, New York, January 31, 1905

the hub spherical with a conical tail piece, and by putting covering plates over the bolts securing the plates to the hub so as to continue the outline of the sphere or conoid.

THE SURFACE CONDENSER.

Up to about 1860 the jet condenser was usually employed on board ship, which meant, of course, that the boilers were constantly fed with salt water; and this, in turn, meant the deposition of great quantities of sulphate of lime scale on the heating surface. About 1860 the use of surface condensation became general, and as this greatly reduced the amount of scale formed it was practicable and safe to increase steam pressures, which accordingly resulted, with a consequent reduction in the weight of machinery per unit of power.

An accompaniment of the introduction of surface condensation, which was at first supposed to be a result of it, but which as a matter of fact was not, was a tremendous increase in the corrosion of the boilers and shortening of their life. An investigation by the Admiralty Committee on boilers in the 70's showed that boiler corrosion was simply rusting and had been due to gross but unintentional neglect.

It has been a very common practise, particularly in naval boilers, when they were not in use, to blow out the water and take off the manhole plates "to let them air." It was this "airing" which caused the corrosion. Now when boilers are laid up they are filled with water which is made slightly alkaline, and this effectually prevents corrosion.

THE CYLINDRICAL BOILER.

The early boilers in seagoing vessels were of the "box" type, the boiler being a cubical box with a thin shell, the real strength being given by braces running in three directions. When surface condensation had made higher pressures possible this led to the design of the cylindrical boiler whose shell was self-bracing, and left the only braces those needed for the heads and flat surfaces. This boiler so thoroughly met the conditions arising that it has remained the favorite even up to the present day.

THE COMPOUND ENGINE.

From a very early period steam had been used expansively in marine engines, and indeed sometimes to a ridiculous extent. Some engineers as late as the Civil War hardly seemed to realize that there was any limit to expansion, altho Isherwood's famous experiments on the "Michigan," in 1861, had demonstrated conclusively that, with low pressures, only a very moderate expansion is permissible. As pressures increased it was natural and correct that a higher range of expansion should be used, and this made practicable the compound engine. As you all know, the compound engine was invented almost as early as Watt's separate condenser, Hornblower's patent dating back to 1771, and Wolff's patent for a two-cylinder engine dating back to 1804. When pressures had gotten up to about 60 pounds, the compound engine began to assert itself.

THE ADVENT OF MILD STEEL.

It is probably difficult for the young men in our technical schools of to-day who are familiar almost entirely with mild steel and very little with wrought iron, to realize what a change came in engineering when the production of mild steel became a commercially reliable matter. The difference between a large wrought-iron shaft such as old Hughey Dougherty used to make at the Morgan Iron Works and one of the mild steel shafts made at Bethlehem is as great as could be imagined. Nearly the same is true of boiler plates. The young engineer of to-day would hardly know what is meant by lamination or a "cold shut." The very method of manufacture made it necessary to use a large factor of safety in designing, with the result that the working stresses permissible were very low and the weight of machinery inordinately high. With the advent of mild steel and the introduction of careful and systematic testing the factor of safety has been reduced from 8 or 10 to 5, and sometimes as low as 4.5. In looking back over my own experience, I do not see how we could possibly have built engines of the size and power now common with wrought iron for pistons and connecting rods and shafting, and it is of course absolutely certain that we could not have built the cylindrical boilers of to-day.

We must not fail to notice in the change to steel the use of steel castings. The first use of steel castings was attended with considerable annoyance, because it was unfortunately assumed, perhaps naturally, that, barring the much greater shrinkage, the material could be treated very much the same as gray iron, and it was consequently asserted with confidence that anything which had been made in gray iron could be made in cast steel. That is doubtless true to-day, but it certainly was not true ten or fifteen years ago, as I know to my personal sorrow.

About the same time that steel came into use, displacing wrought iron, white metal for bearings and the stronger bronzes also came into use, thus giving the designer much better materials to work with and again reducing weights. We may also mention here the gradual displacement of copper for steam piping by steel pipes.

FORCED DRAFT.

In naval machinery forced draft has been of the greatest possible importance, because it has reduced boiler weights probably almost one-half. In the navy the natural limitations as to space and weight prevent the use of forced draft with very much economy of fuel. It is obvious that if the rate of combustion is increased from 15 pounds of coal per square foot of grate to 40 pounds, there ought to be an attendant increase of heating surface. In the merchant service it is possible to do this, and in one of my annual reports I made a comparison between the boilers of a merchant vessel called the "Iona" and those of the "Baltimore." In the "Iona" there were 75 feet of heating surface for 1 of grate, while in the "Baltimore" the ratio was about 30 to 1; but had the "Baltimore's" boilers been designed with any such ratio their weight would have been almost double the weight of all the machinery of that vessel as actually built.

HIGH ENGINE SPEEDS.

About the same time as the reintroduction of forced draft, the improved materials and workmanship made it possible to get higher rotational speeds. Naval vessels, from the necessary limitation of keeping the vital parts of the machinery protected as far as possible, have always run faster than the engines of the merchant service, altho this did not always mean that their piston speed was greater. The mistake is sometimes made of attributing lighter machinery to higher piston speeds, but unless this is accomplished by increasing the number of revolutions it will not produce that effect. In the early days 60 or 70 revolutions per minute for what was then considered a large engine of 4,000 or 5,000 horse-power was about the limit, but in engines of as much as 8,000 horse-power for a single set one finds the revolutions to-day as high as 130. It is interesting to note that in the "Warrior" of 1861, with 22 pounds boiler pressure and 54 revolutions, the horse-power per ton of machinery was 6, while in the "Minneapolis" of 1891, with 165 pounds pressure and 133 revolutions, the horse-power per ton is 10.9.

THE MULTIPLE EXPANSION ENGINE.

As steam pressures rose the leaders of the profession became convinced that to secure adequate economy a further stage of expansion was necessary, and this brought about the triple expansion engine. It seemed a logical extension of this idea that with still further increase of pressure there should be the quadruple expansion engine, and a number of these have been built; but the advantage as compared with the triple expansion engine, up to the point beyond which pressures have thus far not gone, does not seem to be clearly demonstrated, and a great many designers are adhering to the triple expansion engine, with four cylinders—one high, one intermediate, and two low pressures.

WATER-TUBE BOILERS.

The object of the water-tube boiler is to reduce weights, to give greater safety against explosion, greater rapidity of raising steam, and an increase of economy in the generation of steam. The various makes of water-tube boilers divide themselves into two broad, general classes: those with straight tubes of large diam-

(*Continued on page 202.*)

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Are we Being Outdone?

Not long ago the belief was practically universal that American workmen in American workshops were far more ready to accept new ideas and to act upon them than were the workmen in the shops of any other country. Not only was this the universal belief among Americans, but foreigners as well believed it, and of course no such thing as a complete change of faith has taken place with regard to it. Nevertheless, there are people who have changed their minds on this point and, obviously, with more or less reason. The incident of the German workmen who, when they heard of the time that had been made in turning a certain piece in America, promptly beat that time, is being much commented upon and the other day we had the privilège of hearing the story from the lips of the man who was the principal actor in this little international drama of the machine shop. He runs a shop here at home and has had a wide experience in dealing with American shop workmen. In this shop he builds a grinding machine, and in order to get the full benefit of this machine it is important that the work be roughed out on a lathe with no regard to smoothness of surface and scarcely any to accuracy of size or of contour—a cut in which the sole object is to remove the surplus metal in the shortest possible time. Samples of work sent from the German shop in question to be finished were returned with a statement of the time required to do the work. When this statement went into the hands of the German shopmen they promptly said "impossеeble" and other things about the job and Americans generally. But one of them thought it might be true, put a wooden feed pulley on his lathe to get a feed suitable to the requirements and soon was beating the American time on the same job. The American, when shown the job going at the new rate, not only showed his appreciation of it, but suggested a raise in wages for the man, and the mark per day increase he received had a stimulating influence upon others, so that very soon nearly all the lathe cuts in that shop were being taken much faster; the American's expression for it being that in no American shop that had ever come under his observation would the men have been so ready to enter so heartily into a new way of doing work—especially where the new way was to enable considerably more work to be done in a given time.

In a certain British shop a very large grinder built by the same man was installed. It was set at work finishing piston rods for marine engines, and it was immediately seen that it would finish them much faster than they had ever been finished before. The old turner who had always finished these rods came up and watched the grinder for a time, then he said, "Wael, Oi can beat it." He had a tool dressed, spent much time in grinding and oil stoning it to a straight-edge, and eventually had a finishing cut going at a rate which, while it was not quite up to the grinder, was near enough so that no one would find it difficult to believe that he really could "beat it" after a little further effort and a little more experimenting. Asked by the foreman why he had not done it before, he said there "was no eenducement." After the lathe finishing cut had been taken, the rod looked well and felt well, and it looked as tho the grinder had been practically beaten. But the American said, "Now, you will have no objection if I put that rod into the grinder and just touch the wheel to it a little, will you?" "Oh no," they said, "a matter of a thirty-second reduction in diameter won't matter." So the rod was put in and the wheel brought up so as to touch only the high spots here and there and the turner came and looked at it. He well knew what those spots meant and he said, "You can do 'em now. I'll do no more," and went off.

All this the American said was done with very little sign of emotion of any kind, and throughout the whole personnel of the establishment there was the utmost willingness to give the new machine and the new methods its use involved the fullest and fairest possible trial; more of this open-mindedness being apparent than had been found in any American shop whether comparing workmen, foremen or proprietors.

Of course we are aware that one swallow does not make a summer, and we certainly would not conclude from these incidents that foreign workmen have suddenly become more enterprising and progressive than Americans, but foreign workmen and foreign employers as well have been hearing a great deal during the past few years about the superior alertness of American workmen and their much greater willingness to do new things in new ways, and it is but natural that this should produce some effect upon them, while on the other hand there can be little doubt that, taking us altogether as shopmen, we have grown of late years a little less warmly appreciative of new and more efficient ways of doing work. The doctrine of "overproduction" has produced its effect. Men have been laid off because of "overproduction." Cotton has been burned because of "overproduction," while at the same time by no means all of our people have had all the cotton goods they would gladly have purchased if employed steadily at good wages. Many who have assumed to teach workingmen have taught them the doctrine of "overproduction," and many others who have not intended to teach them have by their practise shown their belief in the doctrine. This must produce its effect. If we teach or act upon the assumption that when we have above a certain quantity of a given article of food many must in consequence starve, and that when we have above a certain quantity of wearing apparel, or of material for making wearing apparel, many must in consequence go in-

sufficiently clothed, then it is but a short step and a natural one to conclude that it is a virtue to limit the production of machines and of machine shops. The reasoning is topsy turvy because based upon wrong assumptions and consequently the behavior based upon the reasoning must be wrong and injurious.

Our belief is that machinists, of all others, should be the last to in any way obstruct or restrict the fullest possible use of labor-saving machinery. They live because of the willingness of others to use such machinery. If the production and use of it seems to produce permanent or severe hardship, it cannot in the nature of things be due to the machines, but to wrong economic conditions—to the existence of various monopolies, for instance, and these should be done away with, to the end that all may come more nearly to a fair share of the benefits brought about by the machinery. We sincerely hope the day will never come when American workmen generally will be less willing to go ahead than the workmen of other lands.

Business vs. Monopolies.

The revelations that have been made regarding the doings of the Santa Fé Railroad and the Colorado Fuel & Iron Company, together with the unanimous decision of the United States Supreme Court against the beef trust, again show very vividly the difference between legitimate business organizations that make money by rendering fair equivalent values and wicked monopolies, based upon participation in railroad monopolies, and thriving, not by business ability or by legitimate business effort, but by underhanded and usually unlawful compacts with those having duties as common carriers by which others with equal rights to carry on the same business are either prevented from doing so or ruined in attempting it. There can be little doubt that public sentiment is now at last thoroughly aroused on this subject and that something will have to be done about it. We hope it will be done in full recognition of the fact that the character of a business is not to be judged by its magnitude; that a proper and beneficent business may be a large one and at least fairly profitable, while on the other hand a smaller one may be injurious and unfair to the utmost extreme. The touchstone for judging these things is, it seems to us, the question: Are others engaged, or can others freely engage in the same line of business and carry it on upon the same terms? If they cannot the business is a monopoly and that monopoly should be broken. If they can, then the business is legitimate and should not be interfered with.

In Germany there is a railroad the trains of which, hauling salt, and electrically driven, are run without any men aboard. The current is simply turned on or off at the stations.

New Tools and Machine Shop Appliances.

SPECIAL TOOL FOR VALVE CASES OF GASOLINE ENGINE CYLINDERS.

The illustrations show a special tool made by the Three Rivers Tool Company, Three Rivers, Mich. The construction of this tool is similar to that of the reamers

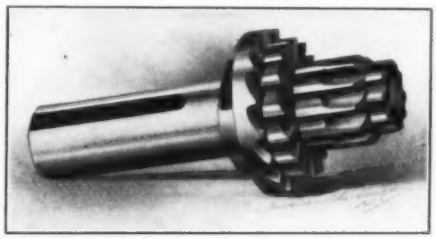


FIG. 1. SPECIAL TOOL FOR VALVE CASES.

made by the same concern, the bodies of the various cutters which go to make the tool being soft steel, while the cutting blades are of high-speed steel inserted in the body and brazed. Provision is made by adjusting screws for maintaining the proper relation between the faced surfaces.

BOWERS' TOOL-HOLDER.

The tool-holder as originally produced was briefly described in our columns at page 917, Vol. 25. It has found such appreciation that the designer has been encouraged to develop it as here shown. The holder is fastened to the wall or against any suitable upright, and consists essentially of three pivoted arms which can be swung out separately, like a towel rack, or be all folded up together, as here shown. These arms provide places for forty-seven files, chisels, bits or other tools. The half-tone shows a metal cabinet which is provided as a part of the holder, the door swinging down over the front when all the arms are swung in close together and fastening with a lock.

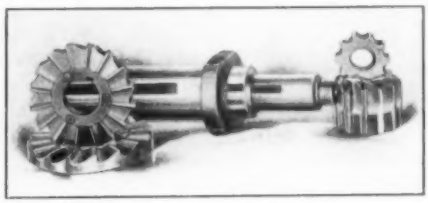
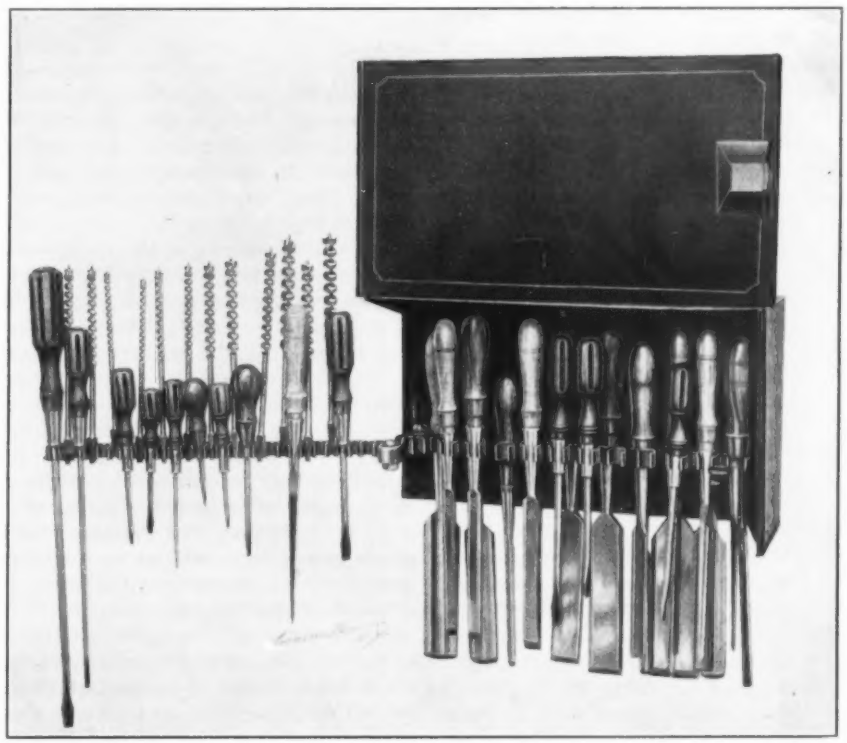


FIG. 2. TOOL TAKEN APART.

The holder is made, either with or without the locking cabinet, by the George W. Bowers Manufacturing Company, Waltham, Mass.



BOWERS' TOOL-HOLDER.

Prizes for Whitworth Thread Limit Gages.

The Engineering Standards Committee (British) are offering prizes for designs of limit gages for Whitworth bolts and nuts. It is understood that the diameter limit which the committee have in view is .001 inch, and the pitch limit .001 inch per inch of thread, but it is obvious that these should not be the same for large and for small sizes, nor for coarse and for fine pitches. Full particulars, however, may be obtained from the secretary, 28 Victoria street, London, S. W.

Epochs in Marine Engineering.

(*Continued from page 199.*)

eter, say 4 inches, and those with curved tubes of small diameter, from 1 inch to 1½ inches. Probably no single boiler possesses all the merits which a perfect water-tube boiler should have, and in nearly every case the attempt to secure certain advantages brings attendant disadvantages, and *vice versa*. The large straight-tube boilers are not so light as the ones with small tubes; and it is more difficult to secure adequate economy, which is dependent largely upon skillful baffling. They do not permit of such rapid raising of steam from cold water as the smaller tube boilers, because, like the Scotch boiler, they carry a large reserve supply of water in the boiler. On the other hand, they permit the replacement of a defective tube and of the cleaning of a tube much more readily than the tubes which are bent. Likewise it is only necessary to carry one size of spare tubes, while the bent tube boilers require several sizes and shapes.

As far as safety against explosion is concerned, there can be no doubt that there is less danger of an actual disaster affecting the whole ship—altho the worst accident which we ever had with a boiler in my naval experience was in connection with a water-tube boiler on a torpedo boat, where all the crew of a fire-room were scalded to death; nevertheless, the boiler itself did not explode and was quite easily repaired. On the other hand, a few years before this a locomotive boiler on a torpedo boat in Germany exploded thru the collapse of the crown sheet due to low water, and not only killed all the people in the fire-room, but tore up the decks and utterly ruined the boiler itself. Since the explosion of the "Thunderer's" boilers in the English navy, many years ago, there is, I believe, no record of the explosion of a large, well-built, marine boiler. Our English friends had some trouble with the Belleville boiler, but this seems to have been due to some extent to lack of familiarity with it, and other legitimate reasons. It seems to me not impracticable that the able men who are engaged in the study of this question will finally succeed in developing a type of water-tube boiler which will commend itself for use in the merchant service as well as in the navy. Some of the boilers fitted in the United States naval ships had but six minutes of water endurance after the pumps stopped working, while one of those the Babcock & Wilcox Company adapted to our naval use has as much as twenty-five minutes endurance, which is a close approximation to the Scotch boiler.

AUXILIARIES.

In the early steamers almost the only independent steam auxiliary was a single pump which could be used for feeding the boilers while under banked fires or with the engine stopped, and for pumping the bilge. The other pumps were attached to the main engine. As time went on, steam capstans and winches and steam steering engines came in. Then it began to be found desirable to remove all the pumps from the main engine, leaving it nothing to do but turn the propeller, and this brought about independent air and circulating pumps and feed pumps. Further progress introduced the distiller and evaporator, the forced-draft blowers and the electric-light engine.

Most of these auxiliaries are driven by simple engines, the pumps usually being for very slow piston speed and without expansion. The result is that the economy of these auxiliaries is very low, and for some years past it has been the aim of designers to do something to either make the auxiliaries themselves more economical or at least to utilize the heat in the exhaust steam.

The question has been raised repeatedly by electrical engineers whether it would not be a good plan to drive the auxiliaries by electric motors, on account of their very high efficiency even at fractional loads. For the engine-room auxiliaries and the boiler feed pumps it seems to me that this is unreasonable, for it means increased complication and certainly an increase in weight. There are some auxiliaries on board ship, however, where it would seem motors could be used to advantage, notably for driving the forced-draft blowers.

THE STEAM TURBINE.

The latest note of progress in marine engineering seems to be the advent of the steam turbine, which for some purposes has passed the experimental stage, and has given great satisfaction. For constant speed at its rated load the turbine is very economical, comparing in this respect with the most economical reciprocating engines, and its economy does not fall off so rapidly with decrease of load at constant speed as is the case with the reciprocating engine.

For marine purposes two questions have bothered those who were seeking information—one, the question of reversal, and the other, that of economy, where not only the power but the speed is reduced. With respect to the former, different methods have been suggested and tried in different cases. In some instances Mr. Parsons has used separate reciprocating engines which are normally idle. In others, and this appears to be in his latest practise, there are reversing turbines inside the exhaust passage of the ahead turbines, so that while the ship is going ahead these turbines revolve idly, after the manner of a flywheel, in an excellent vacuum. When the ship is to be reversed, steam is admitted direct to these turbines and secures the reversal.

With respect to economy, there is of course a marked falling off from that at full power, but not more so than in the case of reciprocating engines. It seems hopeless to expect that any machine will work with the same economy at one-tenth power that it does at full power, and it would be unreasonable to expect the turbine to do this when the reciprocating engine does not.

Propeller design with the turbine is more difficult than with the reciprocating engine, because the conditions are entirely different, and there is so little experience with propellers running at speeds of over 1,000 revolutions per minute in the case of small ships, or at 500 to 750 in the case of large ones. For naval vessels from a military standpoint the turbine has a great deal to commend it, inasmuch as the machinery will stow very well in the ship and be out of harm's way, the propellers are so small and so well immersed that there is no chance for racing even in the heaviest seas, and all questions of vibration are eliminated. As already mentioned, the saving in weight is also a matter of decided value, if it can be done.

The economy of the marine engine, or of the turbine if it displaces the engine, has reached a point which does not leave much room for improvement in materials and workmanship. Yet it will be unreasonable to believe that we have reached finality, for it is likely that there have been numerous periods in the past when the designers of those days could not see what the next step in advance would be, and, so far as their knowledge went, their design was nearly perfect. Of course there was certainly plenty of margin for increased economy with them from which we are barred, but I have no doubt that if I could live to be as old as Mr. Haswell I should see some decided improvements in the course of the next thirty years.

The Trade-Mark Bill.

The Bonynge trade-mark bill has been passed by the House of Representatives without a dissenting vote and is now before the Senate with an excellent chance of its early enactment into law. It changes the method of procedure for the registration of trade-marks. There has been, within the present law, no way by which an appeal could be taken from the decision of the Commission of Patents upon the question whether a mark was entitled to be registered or not, or upon any other question. This bill provides for such an appeal to the Court of Appeals of the District of Columbia, the same as in the patent cases, and the procedure for the registration of trade-marks is modeled after the procedure for the obtaining of a patent. It provides moderate fees for all of the proceedings. It changes the life of a certificate of registration of a trade-mark from thirty to twenty years, to agree with the term fixed by the Patent Division, and in many respects amends the present law so as to make it conform to treaty stipulations. Manufacturers, dealers and others who are interested in this subject can communicate their views to Senator Riltredge, chairman of the Senate Committee on Patents.

Legal Notes.

BY E. P. BUFFET, LL.B.

MONKEYING WITH BUZZ SAWS.

In a recently adjudicated case (Chacraft vs. Bessemer Limestone Company) it has been laid down by the Supreme Court of Pennsylvania (per Potter, J.) that an employer is not bound to tell a person more than twenty years of age, who has been working in the sawmill four months, that if he puts his hand against a buzz saw it will be cut off.

59 Atl. Rep. 432.

IMPLIED WARRANTY OF PISTON ROD; EXPERT TESTIMONY.

The Rollins Engine Company, Nashua, N. H., ordered from the Eastern Forge Company, of the same place, "one steel piston rod as per enclosed blueprint, 21x42" [cylinder]; it was marked on the blueprint "rough turn to figures." The Rollins people finished the rod and installed it in an engine. After it had been in use about a week it broke, damaging the machine. They claimed that the break was due to poor material, but the forge people, against whom they brought suit, contended that the fracture was due to other causes, and their evidence tended to show that the rod had been manufactured by them from a steel billet purchased from a reputable dealer and in which there was no defect discoverable by ordinary care. The jury found for the engine company and the forge company appealed to the Supreme Court of New Hampshire, which has set aside the verdict and granted a new trial.

The court holds that under the circumstances of this case, there was no implied warranty that the rod was free from latent defects, but only that the forge company would exercise due care in the selection of the material. The opinion contains a long discussion of precedents, which enable us to see how close the case is, and how a slight change in the conditions might have led to an opposite result. The facts that the forge company was not expected to be the maker of the steel, that the contract was in writing, and that the engine company did not rely on the forge company's judgment to furnish a suitable piston for a particular engine, or even for a steam engine generally, but prescribed the material and dimensions of the forgings desired—are among the elements to be considered.

In his closing argument before the jury the engine company's counsel said: "There is no testimony in the world so biassed as the testimony of an expert. I am tired of this kind of testimony from experts, who are just as much parties to this defendant's case as the attorneys who stand here. . . . You know that you can get as many experts on one side as on the other, if you go to work and try." These remarks were excepted to and the appeal court regards them as, at least, "dangerously near the line," but they will no doubt awaken a responsive chord in many breasts.

59 Atl. Rep., 382.

LIABILITY FOR DEFECTIVE TRANSFORMER.

An electric company was held in a recent Rhode Island case to be *prima facie* liable for the condition of a transformer thru a burning out, breaking down, or other weakened condition of which a 2,000-volt current went around an incandescent lighting circuit, killing a man in a building who was turning on a lamp. The company may rebut such presumption of negligence, if possible, but a jury is justified in refusing to be satisfied with proof that the machine was purchased from a reputable maker. The questions "Who purchased it and when? How long was it in service, and what was its service? What was its condition at the time of its installation at the place where it gave out? Was it worn out or suddenly disabled? Was it ever inspected after its last installation?"—and others, are pertinent.

59 Atl. Rep., 393.

Monthly Meeting of the A. S. M. E.

The first monthly meeting in New York of the American Society of Mechanical Engineers for the present season was held at the society house, January 31, the president, Mr. John R. Freeman, presiding. Secretary Hutton read a letter from E. R. Archer, chief engineer of the Tredegar Company, Richmond, Va., presenting to the society a piece of armor plate from the U. S. monitor "Montauk." The piece was exhibited upon the president's table. The "Montauk" was one of the monitors which did most conspicuous service in the Civil War. She was hit a great number of times, but no gun of the day was able to pierce her armor. The plate, which is about 7/8 inch thick, has an elongated slot, presumably for a lookout, and below this is a large indentation caused by a heavy shot, but with no suggestion of penetration or any actual severing of the metal. The material of the "Montauk" and some of her consorts is now being converted and used in the building of agricultural machinery at the Tredegar works, thus very literally accomplishing the turning of the sword into the plowshare and the spear into the pruning hook.

The address of Admiral Melville, on "Epochs in Marine Engineering," an abstract of which is given on other pages of the present issue, was listened to with unflagging interest throughout, and tho the topic was, in a way, a familiar one, many unfamiliar facts and original suggestions were brought out. At the beginning Admiral Melville spoke of the absence of lantern slides in illustration of his address, intimating that in his career there had been little *sliding*, but rather continuous and strenuous work. The series of meetings was thus auspiciously inaugurated, and it is to be expected that the succeeding gatherings of this season will also prove interesting and profitable. The next meeting will occur on February 28; speaker and topic will be authoritatively announced later.

New Publications.

"Die Regelung der Kraftmaschinen. Berechnung und Konstruktion der Schwungraeder, des Massenausgleichs und der Kraftmaschinenregler in Elementarer Behandlung." By Max Tolle, professor and machine-construction-school director. Pp. 461, 6x9 inches, with 372 figures in the text and 9 tables. Berlin: Juilius Springer, Monbijouplatz, 3. Price 14 marks.

This book is an outgrowth of some articles by the author on centrifugal governors which were published in the *Zeitschrift* of the German Engineers' Society, in 1895 and 1896, the interest in which has induced such an amplification in book form. The author follows graphical methods as far as feasible and tries to adapt his treatment of the subject to the understanding of the average engineer. It is impossible here to give this work the notice it deserves, but some idea of its scope may be obtained from the main divisions of the subject—Flywheels, Rest (or Stillness) of Motion, Regulation of Number of Revolutions (Governors). These topics are greatly subdivided and many specific makes of governors are considered, largely if not exclusively German.

"Getting a Living: The Problem of Wealth and Poverty—of Profits, Wages and Trade Unionism." By George L. Bolen. 760 5½x8½-inch pages; cloth. The MacMillan Company, New York.

This is a book on a subject that interests most of us, and it deals with matters in which most of those who are connected with industrial operations in any way are especially concerned. We think, however, that it will be found exceedingly difficult to draw any definite conclusions from it. We should judge that the author had for many years been a subscriber to one of the clipping bureaus and had received many thousands of clippings relating to the subjects treated. These he has taken, copied many of them, commented upon many, and in numerous instances, it seems to us, has failed to notice that they are directly contradictory and entirely irreconcilable. The author starts out by endorsing the fourth factor in the production of wealth, which he still more confuses by calling it the "employer's ability for managing and for bearing risks," ignoring the fact that ability usefully employed is labor and is entitled to be compensated as such and in proportion to its value; while "risks" are universally covered by the rate of interest on capital, and are therefore part of the compensation which should go, and actually does go, to capital. Hence there remain the three old, standard, commonly accepted factors in the production of wealth—land, labor and capital—no more,

no less. Labor union men by choosing the right passages in this book could secure its endorsement for everything advocated by them, and, *per contra,* others, not believing in unions, may find all necessary material for their condemnation. A curious example of the author's style is to be found at page 551, where, in discussing the matter of injunctions in strikes, he appears to justify punishments inflicted by judges for violation of injunctions, because after the term in jail imposed by the judge without trial by jury or any of the usual safeguards of accused persons, there is still opportunity for indictment, trial and punishment in the regular way for the same offense. Most of the very many pages of the book are printed in small type. Considerations of space and of time preclude the possibility of reviewing it in detail, and it is perhaps sufficient to say that anyone who wishes to know what has been said and printed on both sides of most of the questions involved in the problem of getting a living can find much of it in this book, the only question the author seems to consistently remain on one side of being protective tariffs, which he is opposed to. One distinctive merit the book possesses is that, taking any given paragraph or sentence by itself, there is seldom the least difficulty in understanding what the author means. He writes in plain terms and does not, as seems to be the case with so many writers on economics, deliberately seek to befog the subject by involved sentences, utterly incomprehensible terminology and the employment of identical terms with entirely different meanings.

"Modern Industrial Progress." By Charles H. Cochrane. 650 6x9-inch pages; more than 400 illustrations. Philadelphia and London, J. B. Lippincott Company.

We must call this a creditable work of its kind. It is of the kind which an industrious man could be expected to make with unlimited access to technical periodicals and trade catalogs. The fields of modern industry and the up-to-date developments of modern invention are very completely covered. The book should be a prize to an omnivorous boy, and a busy man could hardly fail to find in it some items of information in fields of activity remote from his own.

"Structural Designers' Hand Book." By William F. Scott. 158 6x9-inch pages with 51 diagrams. The Engineering News Publishing Company. Price $2.00.

The object of this book is to simplify the laborious calculations connected with structural steel work. To that end a wealth of diagrams is given by which all ordinary problems of this nature may be solved and these are supplemented with the necessary tables of the properties of rolled sections. The book is of large value to all who have to deal with steel constructions. It is of the nature of a pocket book, but, of course, much fuller than the treatment of the same subject which can be crowded into an engineer's pocket book, while the diagrams are unique in their completeness and enormously simplify the calculations to which they apply.

The Isthmian Canal Commission, Washington, D. C., advertises for proposals for rock-drills. Bids will be opened February 28. Those interested can address J. G. Walker, chairman of the commission.

Personal.

Edward L. Harrison, who has been with the Niles-Bement-Pond Company for the last fifteen years, is now connected with Vandyck Churchill Company, 8 Dey street, New York.

A. R. Lentz, formerly superintendent of the Harman-Cogger Company, Bloomsburg, Pa., has recently become superintendent of the Weatherly Foundry & Machine Company, Weatherly, Pa.

Arthur Kayser, of Berlin, who represents there F. A. Errington and is doing missionary work generally on behalf of American tool and machinery builders, is here looking about for a time and will take up the representation of additional specialties. His address while here will be in care of Mr. Errington, 39 Cortlandt street, New York.

Morgan J. Hammers, formerly superintendent of the Phœnix Iron Works Company, Meadville, Pa., has become connected with the Jacobson Machine Manufacturing Company, of Warren, Pa., builder of air compressors and gas and gasoline engines. Mr. Hammers has acquired a financial interest in the concern and is in direct charge of the works.

Obituary.

John A. Weimer, president of the Weimer Machine Works, Lebanon, Pa., died February 4, forty-two years old.

Harrison H. Taylor, inventor of a water-tube marine boiler and a number of other mechanical appliances, died at Detroit, Mich., February 4.

E. Sherman Gould, civil engineer of Yonkers, N. Y., a man of profound learning and great abilities, as well as a charming personality and who contributed a number of interesting and valuable articles to our columns, died in New York, January 24, of pneumonia, at the age of sixty-eight years.

Alexander McGaw, a famous architect and engineer, died in Philadelphia, January 30, seventy-seven years old. He built the pedestal for the Statue of Liberty, the bridge of the New York Central Railroad over the Harlem River, the drydock at Cramp's shipyard, the Girard avenue bridge in Philadelphia and many other structures in different parts of the country.

George H. Perkins, an inventor prominently identified with the oil trade, died at Island Heights, N. J., February 2. He was the pioneer in the manufacture of tin cans by machinery, having factories in New York, Philadelphia and Pittsburg. He was associated with the Atlantic Refining Company, and by his inventions had materially altered the methods of refining oil. Mr. Perkins was a member of the American Society of Mechanical Engineers, the Franklin Institute, and other technical associations.

Business Items.

The Hess-Bright Manufacturing Company has removed to 245-247 North Broad street, Philadelphia, Pa.

The Standard Pressed Steel Company, Philadelphia, Pa., is sending out a large poster showing the "American Pioneer" pressed steel shaft hanger. A copy of this poster, which is very artistic, will be sent to anyone interested, on application.

In equipping its new English shops where the steel cars for the London underground railway are to be built, the American Car & Foundry Company has purchased from the Ingersoll-Sergeant Drill Company its entire pneumatic equipment, including air compressors and Haeseler hammers and drills.

The Bemis & Call Hardware & Tool Company, Springfield, Mass., states that its wrenches have met with such a demand that it has decided to manufacture the larger sizes, and it is now prepared to furnish them in 6-, 21- and 24-inch sizes. The 21- and 24-inch wrenches are also made with steel handles.

The two air compressors shown in Machinery Hall at St. Louis and built by the Laidlaw-Dunn-Gordon Company were sold before the closing day, the larger one going to shaft No. 3 of the Doe Run Lead Company, at Central, Mo., and the smaller one to the city of Columbia, Mo., for the air-lift water supply system.

The S. Obermayer Company, Cincinnati, Chicago and Pittsburg, is placing on the market its Esso Gluetrin core binder. This has been, and is now, successfully used in a number of prominent foundries, in making large as well as small cores. Used in the proportion of one part Esso Gluetrin core binder to eighty parts of core sand, it is, the company says, proving an immense saver of expense. It will send a barrel on approval, with the understanding that if it doesn't save money in the core-room, and at the same time make a good, strong core that can easily be taken from the casting afterward, it will ask no pay.

The Hamilton Cataract Power, Light & Traction Company has started the two 5,000-kilowatt Westinghouse generators in its De Cew Falls power station, in Ontario. Power is supplied from Welland Canal feeders, tapped in about 14 miles above the power station, and at the station the water has a head of 267 feet. The generators are of the two-bearing type, direct connected to Escher-Wyss water-wheels, and run at a speed of 286 revolutions per minute. They generate three-phase current at a frequency of 66 cycles, and a pressure of 2,400 volts. The power is transmitted to the city of Hamilton, Ontario, where it is used for lighting, street railway and manufacturing purposes. A reserve steam-driven station is located at Hamilton, which contains two 1,000-kilowatt Westinghouse generators.

The Geometric Drill Company, being organized under a charter granted by the State of Delaware, which was limited in its duration, decided to reorganize as a Connecticut corporation under the name of The Geomet-

ric Tool Company, with a capital stock $100,000, under an arrangement whereby the stock of the new company was to be issued for the property of the old, and the stockholders of the old company were to receive stock of the new company in proportion to their respective holdings. The laws of Connecticut being favorable to the management of such corporations, there being no annual franchise tax, and as the stockholders were mostly resident in and about New Haven, it was considered much more convenient, as well as economical, to have the corporation located there. The transfer has already been made, the new company assuming the obligations of the old. The balance sheet shows an actual valuation of property in excess of the amount for which the new company is capitalized.

The De La Vergne Machine Company, New York, is building, among other orders, Hornsby-Akroyd oil engines for the following concerns: United States Navy Department wireless telepgraph station, two 50 horsepower; Indianapolis Pipe Line Company, Geneva, Ind., one 32 horse-power; Ohio Oil Company, Findlay, Ohio, one 25 horse-power C. M. Holbrook, Oil City, Pa., two 32 horsepower; the Charles Mills Supply Company, New York city, one 13 horse-power, one 7 horse-power; E. C. Bumiller, Iquique, Chili, two 4 horse-power; Thirteenth Regiment Armory, Brooklyn, N. Y., one 20 horse-power; Honolulu Iron Works, one 32 horse-power; Balbach Smelting & Refining Company, Newark, N. J., one 50 horse-power; C. E. Hewitt & Co., New York city, one 125 horse-power; Boston Lighthouse Department, two 4 horsepower; Bristol Electric Light Company, Bristol, N. H., one 50 horse-power; Armour Car Lines, Chicago, Ill., two 125 horse-power; Thos. Stephens & Sons, Ltd., Albany, N. Y., one 16 horse-power; Remington Machine Company, Wilmington, Del., one 1½ horsepower; Lighthouse Department, Tompkinsville, S. I., two 13 horse-power; Lighthouse Department, Milwaukee, Wis., four 16 horsepower; the Andrews-Doron Company, Los Angeles, Cal., one 50 horse-power, two 125 horse-power.

Manufacturers.

The Celluloid Company, Newark, N. J., will enlarge its plant.

The Schwab Safe & Lock Works, Lafayette, Ind., will erect a new foundry.

The J. A. Fay & Egan Company, Cincinnati, O., will enlarge its plant.

The Meredith (N. H.) Electric Light Company will build a new power-house.

The Malleable Range Company, Beaverdam, Wis., is enlarging its plant.

The Belton (S. C.) Manufacturing Company will enlarge its cotton mills.

T. M. Michaels, Knoxville, Tenn., is erecting a sash, door and blind factory.

Floyd, Wells & Co., of Royersford, Pa., will build an addition to their foundry.

The Crane Company, Chicago, Ill., will erect a branch factory in Omaha, Neb.

It is said the National Scale Company, Boston, Mass., will build an iron foundry.

The Clarksdale (Miss.) Machinery Supply & Manufacturing Company has been organized.

Chanute (Kan.) Cement & Clay Product Company will erect a Portland cement factory.

The Lorain (O.) Sand & Gravel Company has been incorporated and will establish a plant.

The Armstrong Bros. Tool Company, Chicago, Ill., will construct a new plant, to cost $75,000.

Fire in the power plant of the Terre Haute (Ind.) Electric Company caused a damage of $100,000.

The Greenwich (N. Y.) Knitting Company has been incorporated with a capital stock of $100,000.

The plant of the Valley Oil Mills, Memphis, Tenn., was destroyed by fire; loss, about $150,000.

The Crompton-Thayer Loom Company, Worcester, Mass., will build an addition to its plant.

One of the factories of the Olean (N. Y.) Glass Works was destroyed by fire. It will be rebuilt.

The Miracle Building Stone Company, Minneapolis, Minn., will erect a plant in Albany, Ga.

The Summit Foundry Company, of Geneva, N. Y., will establish a branch factory in La Crosse, Wis.

Fire damaged the plant of the Prospect Dye Works, Reading, Pa., to an extent of about $30,000.

The plant of the United States Cast Iron Pipe & Foundry Company, at Anniston, Ala., will be enlarged.

The Darby Canning Company, W. Jefferson, O., will erect a new plant, installing modern machinery.

The Grand Trunk Pacific Railway Company will erect shops and a union depot at Edmonton, N. W. T.

The Phillips & Butlorff Manufacturing Company, Nashville, Tenn., will build an addition to its foundry.

The Winnes Paper Company, Cincinnati, O., will enlarge its plant and add woodenware to its products.

The Urbana & Champaign Railway, Gas & Electric Company will erect an auxiliary plant at Champaign, Ill.

The Chattanooga (Tenn.) Implement & Manufacturing Company will erect a new foundry, to cost $50,000.

The Southern Cotton Oil Company's plant, at Bennettsville, S. C., has been destroyed by fire; loss, about $100,000.

The electric light and power plant of the Laurel (Miss.) Improvement Company has been burned; loss, $25,000.

The Cape Fear Manufacturing Company, Greensboro, N. C., whose lumber plant was completely destroyed, will rebuild.

The Geo. H. Lee Company, Omaha, Neb., manufacturer of tanks, etc., will open a branch factory in Winnipeg, Man.

The Glassport, Pa., plant of the United States Gas & Coke Company, which was badly damaged by fire, will be rebuilt.

The plant of the Menominee (Mich.) Electric Manufacturing Company was destroyed by fire, entailing a loss of $50,000.

The Federal Granite Brick Company, Scranton, Pa., proposes to erect a plant in Sayre similar to the one in Scranton.

The Gravity Controller Company has been incorporated; capital stock, $100,000. President, George A. Seiders, of Portland, Me.

The Power Mining & Machinery Company, New York, will erect a new plant at Linden, N. J., which will employ about 3,000 men.

The Grand Rapids (Mich.) Edison Company will increase the capacity of its several plants at an expenditure of about $100,000.

The Walsh Brake Shoe & Foundry Company will remove from Chicago to East Rock Island, Ill., where a factory has been erected.

It is said the Hart-Cooley Company, New Britain, Conn., which manufactures pressed steel registers, will erect an additional factory.

The Tutwiler Coal, Iron & Railway Company is putting up a 200-ton blast furnace at Vanderbilt, Ala., and 100 coke ovens at Short Creek.

The factory of A. B. Brown & Co. Dubuque, Iowa, was totally destroyed by fire. The company manufactured wooden tanks and boxes.

The Monarch Paper Company, Kalamazoo, Mich., has been organized with a capital stock of $150,000 and will erect a two-machine mill.

The Birmingham (Ala.) Railway, Light & Power Company will make extensive improvements in its equipment. About ..00,000 will be expended.

The Cincinnati Northern Traction Company has been organized with a capital stock of $500,000, and will erect a power plant at Hamilton, O.

The Charles McCaul Company, of Philadelphia, Pa., has a contract to build a $20,000 shop for the Belmont Iron Works, at Eddystone, Pa.

The People's Company, Springfield, O., formerly the Citizens' Lighting, Heating & Power Company, will erect and equip a plant, to cost $500,000.

The Hopkins Bros.-Springer Company, Des Moines, Ia., will open a foundry for the manufacture of a brazing fluid. New machinery will be installed.

Finley & Campbell, of West Newton, Pa., will erect a planing mill, which will be equipped with a large gas engine and all the necessary modern fittings.

F. L. Preston, Boulder, Colo., formerly head of the Preston refining works, will erect a factory for the construction of his machinery used in the refining of ores.

The Maine & New Brunswick Electric Power Company will put up a plant in Aroostook Falls, Me. Arthur R. Gould, of Presque Isle, Me., is a leader in the enterprise.

A concentrating mill, to treat lead and silver ores, will be built at once at Velardena, Mex., it is reliably reported, by the Velardena Mining & Smelting Company.

The C. E. Little Company, Cincinnati, O., manufacturer of porch columns, etc., whose plant was burned out some time ago, has been incorporated with a capital stock of $20,000.

The Georgia Cordage Mills have been organized, with C. M. Chandler, president. This company has established at Decatur, Ga., an initial plant, which may be enlarged later.

The Brandon (Man.) Developing, Manufacturing & Supply Agency, Ltd., has been incorporated; capital, $40,000. The company will deal in all kinds of cement, machines, engines, etc.

The joint factory of the Howard Thermostat Company and Oswego Carriage & Boiler Company, Oswego, N. Y., was damaged by fire to the extent of several thousand dollars. It will be rebuilt.

J. T. Polk Canning Company, of Greenwood, Ind., is trying to buy a plant in Paducah, Ky. If they are successful the plant will be greatly enlarged, and if unsuccessful they will erect a factory there.

Some improvements will be made at the factory of the Price-Klein Company, Owensboro, Ky., furniture manufacturer, to facilitate the manufacture of its specialties. New machinery will be installed.

It is announced that the American Steel Foundries, Franklin, Pa., have purchased the business of the Simplex Railway Appliance Company, including its Chicago plant, which will be moved to Franklin.

The Lumberton (N. J.) Light, Water & Sewage Company has been formed with a capital of $50,000, which will be used in the erection of water and lighting plants and the installation of a sewer system.

The Gwynne-Treadwell Cotton Company has filed an application for a charter, with a capitalization of $100,000. The incorporators are Andrew D. Gwynne, Lawson H. Treadwell, of Memphis, Tenn., and others.

At a meeting of the city council of Manitowoc, Wis., the question of municipal ownership was discussed, and the city engineer instructed to prepare estimates on the cost of an electric lighting plant and submit same.

The Bethlehem Steel Company will enlarge its plant at Bethlehem, Pa., and will enter upon the manufacture of crucible steel high-grade castings and steel springs. About $5,000,000 will be expended for improvements.

The executive committee of the Capitol Extension Commission are examining plans for the proposed heat, light and power plant, which the State has authorized for the capitol, library and executive mansion at Richmond, Va.

J. E. Mergott Novelty Manufacturing Company, Irvington, N. J., whose plant was totally destroyed by fire, will probably rebuild. The company has secured temporary offices in the Liberty Building, Clinton street, Newark, N. J.

The Union Paper Cup Company of Pennsylvania has been incorporated, with offices at 3951 Market street, Philadelphia; capital stock, $200,000. This company will manufacture water-proof paper containers known as paper milk bottles and drinking cups.

The Chamber of Commerce has completed a contract with the American Fuse Company, of Chicago, under which the large business of this company now conducted at Adrian, Mich.; Milwaukee and Chicago, will be moved to Muskegon, Mich. This company manufactures electric fuses, telephones, controllers, etc.

The Nipe Bay Company, of Boston Mass., has been organized by Boston capitalists identified with the United Fruit Company, to exploit 130,000 acres of Cuban sugar lands, situated on Nipe Bay. It is proposed to erect a sugar house capable of converting 5,000 tons of sugar cane daily, equal to about 450 tons of sugar a day.

J. J. Henry, Denver, Colo., a projector of electrical enterprises, has purchased two electric lighting plants of the Black Hills region of South Dakota, that of the Black Hills Electric Light Company at Deadwood and the Belt Light & Power Company at Lead. He will consolidate the two and build a new plant at Pluma. The estimated cost of this plant will be $1,000,000.

New Catalogs.

L. Robbins, 42 Lagrange street, Worcester, Mass. Circulars describing engine and patternmakers' lathes. Illustrated. 6x9.

Standard Roller Bearing Company, Philadelphia, Pa. Catalog of ball and roller bearings. Illustrated. 6½x9½, pp. 63, linen.

Electro Dynamic Company, Bayonne, N. J. Circulars 1, 2, 3, Series "B," describing Inter-Pole variable speed motor. Illustrated. 6x9, paper,

Hendey Machine Company, Torrington, Conn. Catalog of new pattern Hendey-Norton lathes. Excellent half-tone illustrations. 6x9, pp. 79, paper.

Queen & Co., Inc., 1010 Chestnut street, Philadelphia, Pa. Circular describing various instruments for resistance measurements, etc. Illustrated. 8x10. paper.

Northern Electrical Manufacturing Company, Madison, Wis. Bulletin No. 45, describing the Northern multi-speed motor. Illustrated. 7x10, pp. 8, paper.

R. D. Nuttall Company, Pittsburg, Pa. Catalog No. 9, January 1905. Mine and industrial machinery gears and pinions. Illustrated. 7½x9½, pp. 49, paper.

Morse Chain Company, Trumansburg, N. Y. Catalog No. 7, describing the Morse rocker joint, also containing tables and other data. Illustrated. 6x9, pp. 19, paper.

Westcott Chuck Company, Oneida, N. Y. Catalog A, "Westcott's" patent lathe chucks and "Little Giant" drill chucks. Half-tone illustrations. 6x9, pp. 32, paper.

The L. L. Lord Company, Meadville, Pa. Catalog of tools and specialties for machinists, water, gas works, railroads, mills, etc. Illustrated. 3½x6½, pp. 20, paper.

Pedrick & Ayer Company, 85 Liberty street, New York. 1905 catalog, describing air appliances and railroad special repair tools. Illustrated. 6x9, pp. 56, paper.

Allis-Chalmers Company, Milwaukee, Wis. Publication No. 117. Gates rock and ore breakers, styles "D" and "F," and auxiliary machinery. Illustrated. 8x10½, pp. 35, paper.

The Jeffrey Manufacturing Company, Columbus, Ohio. Bulletin A. This describes the novel coal and ashes distribution plant installed by this company. Illustrated. 6x9¼, pp. 6, paper.

Walter Macleod & Co., 213 East Pearl street, Cincinnati, O. Catalog No. 70. Labor-saving specialties, comprising oil burners, oil furnaces and forges, sand-blast machines, etc. Illustrated. 4x9, pp. 48, paper.

The Whitman & Barnes Manufacturing Company, Chicago, Ill. Catalog No. 56, describing twist drills, drop forged and screw machines, also other machine shop and mill supplies manufactured by this company. Half-tone illustrations. 6x9, pp. 110, paper.

Rand Drill Company, 128 Broadway, New York. "Air Power." This is the first number of a publication which will be issued quarterly by this company. The object of the paper primarily is to keep in touch with compressed air users and to educate them to feel that they can call upon the company whenever they wish to ask questions or discuss any subject pertaining to the varied uses of compressed air.

"Books and Things" is the title of a catalog sent out by the Derry-Collard Company, 257 Broadway, New York, which contains lists of books published and handled by this company. It describes the Derry-Collard method of sending books on approval and the Derry-Collard book club. The books listed are selected works on mechanical subjects, and they are classified so that any particular book or group of books can readily be found. There are shown, also, other Derry-Collard specialties.

Miscellaneous Wants.

Advertisements will be inserted under this head at 25 cents a line each insertion. Copy should be sent to reach us not later than Saturday morning for the ensuing week's issue. Answers addressed to our care will be forwarded.

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Punches & dies. Wal.M.Wks.,Waltham,Mass.

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Will buy or pay royalty for good patented machine or tool. Box 282, AMER. MACHINIST.

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A set of steel figures, size 3-32 or ⅛ in.; $1.25, post paid. J. L. Lucas, Bridgeport, Ct.

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For Sale—Long-established machine shop in this thriving city; cause of sale, death in firm. W. D. Judson, New Haven, Conn.

For Sale—A machine shop; price $3,500; business shows for last year 11 per cent. net profit on the inventory. Address Box 277, AMERICAN MACHINIST.

I can sell your machine shop (or other business), with or without real estate, no matter where it is or what it is worth. Send description, state price and learn how. W. M. Ostrander, 111 North American Bldg., Philadelphia.

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Wants.

Situation and Help Advertisements only inserted under this head. Rate 25 cents a line for each insertion. About six words make a line. No advertisements under two lines accepted, and no advertisements abbreviated. The cash and copy should be sent to reach us not later than Saturday morning for the ensuing week's issue. Answers addressed to our care will be forwarded. Applicants may specify names to which their replies are not to be forwarded; but replies will not be returned. If not forwarded they will be destroyed without notice. Original letters of recommendation or other papers of value should not be enclosed to unknown correspondents. Only bona-fide situation want or help want advertisements inserted under this heading. Agency advertisements must be placed under Miscellaneous Wants.

Situations Wanted.

Classification indicates present address of advertiser, nothing else.

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Broadly qualified machine works general superintendent, desiring new location, invites confidential inquiries; state particulars. "Conservant," care AMERICAN MACHINIST.

Superintendent, age 34; wide experience manufacturing small and medium sized machinery, tools and metal specialties; knows how to handle men and turn out work; highest references. Box 248, AMER. MACHINIST.

Permanent position, by quick estimator and competent designer of inventive and

The United States Arsenal at Rock Island—III.

BY F. A. STANLEY.

Returning now to the remaining factories in Arsenal Row, we will consider first shop C, in which the equipment, wood-working and tin shops are established and which employs a total force of about 350 hands.

THE CARPENTER SHOP.

This department occupies the whole of the west wing of the building, and turns out all classes of wood work. The planing and cutting departments are in the basement, as are also the packing and crating departments and the wagon and paint shops. Like the floors above, the basement has an exhaust system for collecting dust and shavings from the wood-working machinery, two exhaust fans driven by one motor sending the refuse thru piping to the boiler-house in the adjacent courtyard, where it is discharged directly into the furnaces or into bins.

On the first floor, where the foreman's office and the toolroom for storing and sharpening cutters and tools are located, packing cases, ammunition chests, arm racks, etc., are made; also saddle trees and wooden stirrups are manufactured in large quantities, and several such pieces in various stages of evolution will be noticed in the central group of Fig. 19; the right- and left-hand panels in that photograph being taken up largely with equipment and tin-shop products. The lathes which shape up the saddle trees in the several operations, are constructed on much the same lines as the gun stock or butt turners fashioned after the Blanchard lathe.

The second floor is known as the bench floor, and is used largely by general carpenters and joiners; the pattern work is done here, too. A representative view in the carpenter shop is given in Fig. 20.

THE EQUIPMENT SHOP.

For years this has been as it is to-day, one of the most important of the manufacturing departments at the arsenal. And it is certainly one of the most interesting. For its product includes an immense variety of such pieces as bits, stirrups, chains, buckles, rings and other attachments entering into the cavalryman's equipment; officers' insignia, and gold and silver badges—as in Fig. 21—for sharpshooters and others; and knives, forks and spoons, and canteen nozzles and rings, which, combined with the product of the tin shop, help make up the mess equipment required by both cavalry and infantry. And this material is turned out in great quantities too. Just note a few selections from a thousand and one orders: "220,000 forks," "195,000 spoons," "542,000 haversack attaching hooks," "507,000 brass end attachments for canteens." Where do all these things go? Well, a great many into the reserve stores accumulating in readiness for the demands of the future; and a great many more into immediate service, as an army of 60,000 men depends entirely for supplies of this character upon Rock Island Arsenal.

For the economical production of such work the equipment department (occupying the first floor in the east wing of shop C) has been fitted up with numerous automatic wire-working machines, screw machines, punch presses, and special appliances, and an excellent idea of the appearance of this room is given in Fig. 22, where several of the wire formers are shown in the foreground, with an inspection room in the enclosure to the right. The wire machines are used extensively for shaping from the coiled stock, rings, buckles, etc., which afterward are welded or brazed, according to the material from which they are formed. Harness rings, trace chain links, curb bit rings, etc., are welded by electricity, two electric welders being installed on a bench at the side of the room. The ring is simply dropped on a couple of innocent appearing copper blocks, a handle is drawn down, clamping the piece fast, then a lever throwing on the current is operated with the left hand and in an instant the ends to be joined are at a white heat. The right hand at this moment pulls a second lever which shoves the ends of the work hard together, the controller for the current then automatically releasing and rising to normal position. The joint formed is a neat one and a strong one as well, as the ring can be doubled over with the hammer and knocked into all sorts of odd shapes without opening.

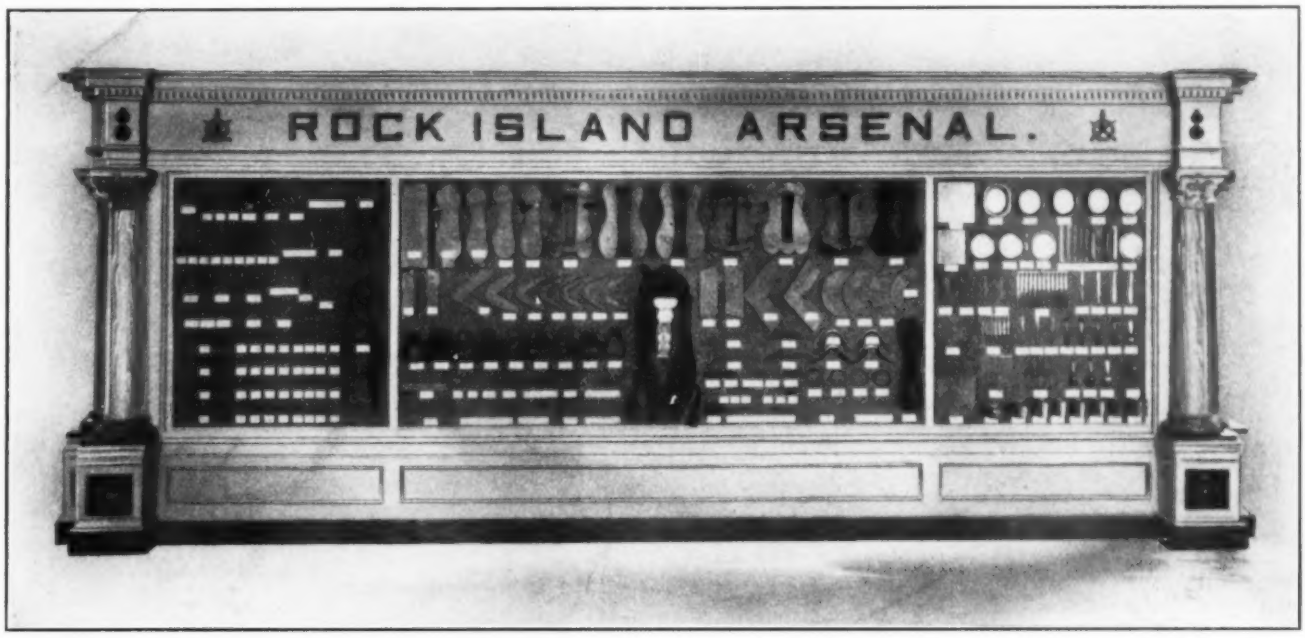


FIG. 19. EVOLUTION OF SOME OF THE PRODUCT OF THE WOOD-WORKING, EQUIPMENT AND HARNESS SHOPS.

Work which requires enameling is finished in the basement where the tanks and ovens are placed. Two electric ovens are used and these have three compartments each, into which the work receptacles may be easily slid. Acid baths and hot and cold water tanks, which are utilized in cleansing metal parts, are located in the basement, where there are also steam drying rooms, a tumbling department for cleaning and burring small castings, etc. The acid baths are entirely enclosed with a hood having a sliding section to admit work, and they are provided with an exhaust system for carrying away the fumes so that the dipping and cleansing rooms are entirely free from the odors frequently encountered in such departments.

AUTOMATIC BRAZING MACHINES.

Some highly ingenious machines have been constructed at the arsenal for use in the equipment shop in automatically brazing buckle frames and similar pieces, and

two of a group of three of these machines are represented in Fig. 23. Each machine will be seen to consist principally of a large turret or dial *A*, about the perifery of which are formed a series of pockets to receive the work. A magazine to hold several score of pieces is provided at *B* and under this the dial rotates continuously, but slowly enough to allow a blank to drop into each pocket. Three cans or drip cups at *C* contain respectively borax and water; fine spelter, borax and water; and fine spelter and borax dry. As the work passes beneath, each piece is treated with flux and brazing material and each cup is opened and shut off automatically to prevent waste. At the rear is a bricked up gas furnace *D*, protected ordinarily by an asbestos guard *E*, and thru the mouth of which the dial swings with the parts to be brazed. The rotating carrier holds forty buckles and makes approximately one turn per minute; and as the furnace mouth is wide enough to expose six or eight pieces simultaneously to the action of the heat, the brazing material has ample opportunity to flow into the joint of the work before the latter is carried beyond the zone of high temperature. An automatic ejector empties each pocket as it approaches the magazine.

A SOLDERING MACHINE.

The machine *F* to the left of the brazers is a semi-automatic device for soldering heads and partitions in oil cups issued with magazine rifles. A number of these oilers are on the bench near the machine and, as will be noticed, they are of tubular form, being cut from ¾-inch brass pipe to a length of about 6 inches. Each tube is divided into two compartments by a circular partition at the center, and one end is adapted to hold oil, the other to receive a thong and brush for cleaning the rifle. This latter end is closed by a screw cap; the oil chamber is closed by a cap soldered in place but tapped out to receive a nurled cap which carries a flattened lubricating wire. In assembling, one of the two boy attendants at the soldering bench pushes a flanged disk half way down the tube, and drops a ring of soldering wire on top, then pushes the permanent head into position with another solder ring resting on this, each piece being dipped in acid as it is picked up. Then the tube is slipped over one of the twelve vertical studs on the machine turret which rotates slowly past a gas torch under air blast at the back, and about twenty-five oilers are soldered in this way per minute.

THE TIN SHOP.

The business of the tin shop is carried on in the second floor of shop C immediately over the equipment shop, and in the basement where a number of its heavier presses are installed and its tinning and galvanizing plants located. A view of a portion of the second floor is given in Fig. 24, and some of the varied product is shown quite conspicuously, the several trucks in the foreground containing canteens, cups, and meat cans, while galvanized powder cans, muzzle covers for big guns, and other work of a heavier nature will be noticed farther to the rear. At the lower end of this same floor is a large polishing room with an excellent dust collecting system, and at the other end a plating department.

Perhaps the most interesting of the tin-shop manufactures are the cups, meat cans and canteens just referred to, and of which 3,000 each may be turned out in a day if necessary. These are illustrated pretty clearly in Fig. 25, tho, as photographs of several groups have been combined in the one engraving, the different pieces, as will be observed, are not reproduced in their true relative proportions. The canteen shown at the bottom of the half-tone is formed of two tin plates struck up into the shape indicated and then, after one is slightly dished at the center, to cause the utensil to rest easily on the carrier's hip, each plate is notched, the two are soldered together and the nozzle and side rings soldered in place. Then, after testing, the felt casing is sewed on and the canvas cover and leather strap attached. The canteen holds two and a half pints of liquid. The test it is subjected to is the same as that applied to powder cans and some other sheet-metal receptacles; that is, the utensil is attached to an air hose, dropped into a tank of hot water and air at 15 pounds pressure admitted. Any leak is of course instantly detected by air bubbles; and as the water is hot there is little danger of rusting the work.

FIG. 21. OFFICERS' INSIGNIA AND SHARPSHOOTERS' BADGES.

Cups like the one shown to the right of the canteen group are drawn up and then tinned. They are also made of aluminum. Several drawing and annealing operations are necessary to bring the cup to length, and after the rough end is trimmed off it must be rolled over. The side of the cup is punched for three rivets and after the handle is blanked out, bent up and punched it is riveted in place under a machine. In the aluminum cup fiber washers are placed between cup and handle to prevent the latter from heating uncomfortably.

The meat can, several views of which are presented in the group above the canteen, is composed of body, cover and handle, the latter snapping over the cover and edge of the can and holding the affair closed and compact when not in use. The can forms a very convenient cooking utensil with the handle opened out, and is

FIG. 20. VIEW IN THE WOOD-WORKING SHOP.

FIG. 22. VIEW IN THE EQUIPMENT SHOP.

made in steel tinned over, and also of aluminum. Of the group to the right, the knife forms the most interesting feature, as it is a composite affair, with a serviceable steel blade tinned, and aluminum handle. It is light, strong and easily kept clean.

Before leaving shop C mention should be made of the well-equipped printing plant established at one end of the main floor of this building and doing all the printing required by the post.

THE HARNESS SHOP.

This department occupies the whole of shop I—the last one in Arsenal Row—and its product, while confined mostly to leather and canvas goods, is about as varied as that of the equipment and other departments in shop C. The first floor in the west wing is known as the cloth department, which makes up haversacks, pouches for "first-aid" packets, breech covers for heavy guns, nose bags, and an endless variety of things generally, most of which are handled on sewing machines. On the same floor, in the front section of the building, is located the hand cutting department for leather for harnesses, saddles, etc.; and in the east wing is the press department, represented in Fig. 26, where all heavy pieces and awkward or irregular shapes are cut from leather stock by means of dies and presses. Straps, etc., are punched here; and molded leather shapes formed under presses which use brass dies as other metal discolors the leather which has to be thoroughly moistened preliminary to shaping. At the rear of the room is a brush-making plant.

The greater part of the floor above is occupied by harness makers working at benches, as in Fig. 27, and making artillery harness, bridles, halters, saddles, saddle bags, etc. Leather leggins, rifle scabbards, pack outfits are also made here, stirrups are covered with leather and various other jobs of an interesting nature performed. The upper floor in the building is utilized as a storeroom for much of this finished leather product. Over 600 workmen are employed in the harness shop, and a few of the many nice pieces of work which they turn out are represented in Fig. 28.

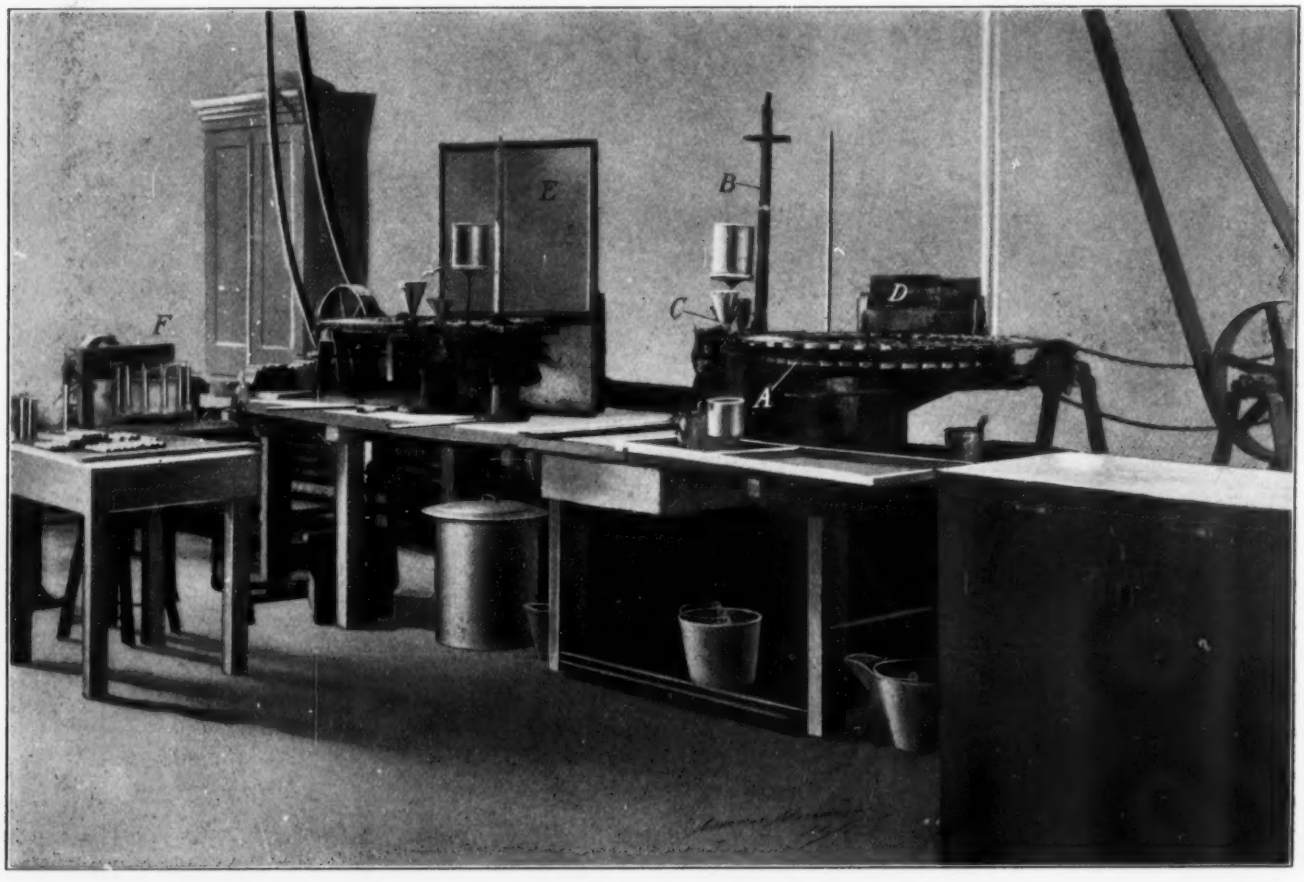


FIG. 23. BRAZING AND SOLDERING MACHINES.

Of course the metal work entering into the construction of these is made in the equipment shop.

SOME FEATURES OF BOTH ARSENAL AND ARMORY ROWS.

We have now in a general way been over the principal operations in Arsenal Row, and in the carrying on of which nearly 2,000 men are employed. And, having finished for the present with one line of shops, it may not be out of place, before taking up a description of the other row, to make a few observations pertinent to both: Enough views have already been presented to bring out the facts that the shops are well lighted and that the machinery, often necessarily of a diversified character, is well arranged. Other facts not brought out by the engravings, however, are that the buildings are comfortably heated; are equipped with commodious electric elevators, and each shop has a reservoir connection and fire hose to be used under circumstances not requiring the fire engine to be called into service. Convenient communication between all the shops in either row is made possible by the system of subways or tunnels previously mentioned and which not only form a means by which work may be readily trucked from shop to shop, but also form passages for the large steam mains for heating the shops and for the electric cables carrying current to the various motors. Furthermore, each department is supplied with lockers, closets and washrooms for the employees, and provision is made in each building for taking care of a large number of bicycles. A regular system of fire alarms has been installed on the island; and all departments of the plant are connected by an automatic telephone system.

As no civilians live on the island, one of the problems arising with the plant development and the rapid increase in the number of employees, was the means of transportation for those living at such points as to make walking to and fro out of the question. Many of the men solved the problem with the aid of the bicycle. And about five years ago the Tri-City

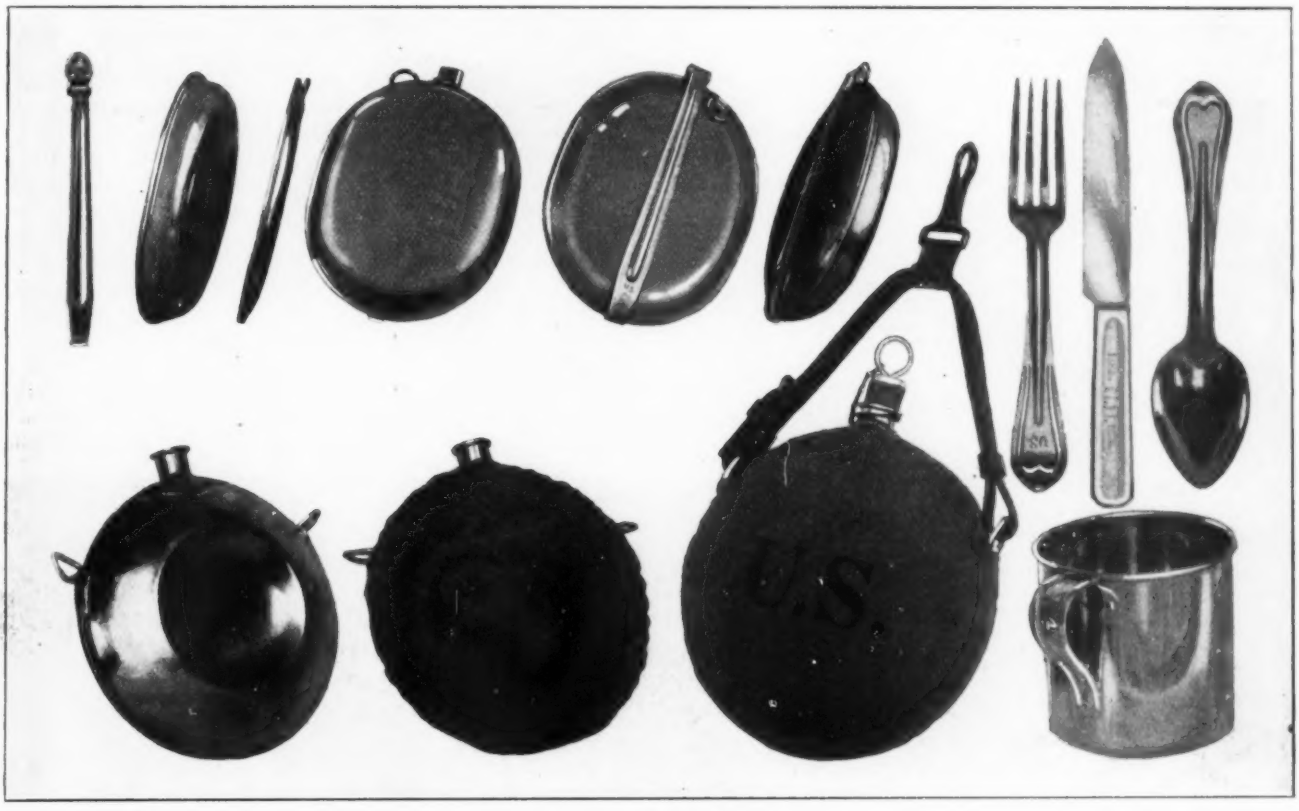


FIG. 25. SOME TIN-SHOP PRODUCTS.

FIG. 24. VIEW IN THE TIN SHOP.

Electric Company extended a branch of its line from Fort Armstrong avenue up thru the grounds and past the rear of the south row of shops, and here any afternoon at 4.30 one may see a line of thirty trolley cars awaiting the coming of the men from the shops. For the working hours at the arsenal are from 8 A. M. to 12 and from 12.30 to 4.30 P. M., the recess at noon being a short one, as it is impracticable in any case for the men to go home to lunch. In groups of three cars each the trolley train leaves the island, and the passing of these cars thru the streets of the three cities is, to the stranger at least, a unique and quite interesting feature.

Annual Report of the Krupp Works.

When Krupp, of Essen, died the vast works which he had built up were transferred to a company, whose first annual balance sheet has recently appeared. The net profits for the year amounted to $2,890,000. Of this amount $2,400,000 went to pay a 6 per cent. dividend, $144,000 to the statutory reserve, $150,000 to a special reserve fund, and $125,000 to a fund for the relief of workmen. The share capital of the company amounts to $40,000,000, and 4 per cent. obligations have been issued to the amount of $9,750,000. A savings bank for the work people has a balance of $5,750,000. The addition to the workmen's relief fund was about 4 per cent. of the net earnings.

Locating the Decimal Point With the Slide Rule.

BY H. B. M'CABE.

To the learner using a slide-rule a great stumbling block will usually be found in the correct placing of the decimal point. Altho a seemingly simple operation, his conception may not be clear enough to make the rules usually given apply to all problems, and when he comes in contact with one like those given below he may become confused.

I shall here refer only to problems in multiplication and division and assume that in division the divisor is always on the slide, the dividend and quotient being on the stock. The usual designation for the four scales will be used, viz., *A, B, C* and *D*, *A* and *D* being respectively the upper and lower scales on the stock, *B* and *C* being respectively the upper and lower on the slide.

The rules for placing the decimal point are usually for the lower or *C* and *D* scales, the preference for these scales being due to their larger size. Many, however, prefer to use the upper ones. It is difficult to state rules that will apply literally to both sets of scales because the upper ones have the advantage of two scales placed in succession, allowing us to find our results by working continuously in one direction instead of jumping from one end to the other, so to speak. The following is the clearest way I know of stating these rules to be used with either set of scales.

Any problem in multiplication or division must come under one of two cases which determine the number of integers in the result. The problem comes under case 1 on the lower scales when in the setting, the slide projects to the left and on the upper scales when we must use both sections of the *A* scale. The problem comes under case 2 on the lower scales when, in setting, the slide projects to the right or on the upper scales when the operation can be performed entirely on one section of the *A* scale.

In multiplication if the problem comes under case 1 the number of integral places in the product will be the sum of those in the factors; if under case 2 the number of integral places in the product will be this sum less 1.

In division if the problem comes under case 1 the number of integral places in the quotient will be those in the dividend less those in the divisor. If under case 2 this difference must be increased by 1.

These rules are assumed to apply to all problems and they no doubt will if used with a very clear mathematical conception, which we do not all possess.

Following are a few examples:

1. Multiply .332 by .0047.
2. Multiply .0268 by .0025.
3. Divide .0199 by 5.
4. Divide 147.5 by .025.

FIG. 26. THE MACHINE ROOM IN THE HARNESS SHOP.

5. Divide .09 by 62.5.

The rules do not seem to apply easily to these problems, and while a clear knowledge of principles may indicate where the point should be, yet mistakes are likely to occur, and after all there may be left a sense of doubt which is aggravating and is dispelled only by going back to the old process. For such problems as these, I have devised the following rules to be used in conjunction with those given above.

In multiplication: Regard the factors as whole numbers. Apply the rule to the product, and if necessary annex ciphers to give it the required number of figures. Then point off as many decimal places to the left as the sum of the decimal places in the factors.

In division: Regard the terms as whole numbers. Point off the quotient according to rule, using an accent mark for a temporary decimal point (thus 3'82). Find the difference between the numbers of decimal places in the terms, and place the permanent point that many places to the left or right of the temporary point. If the number of places in the dividend exceeds

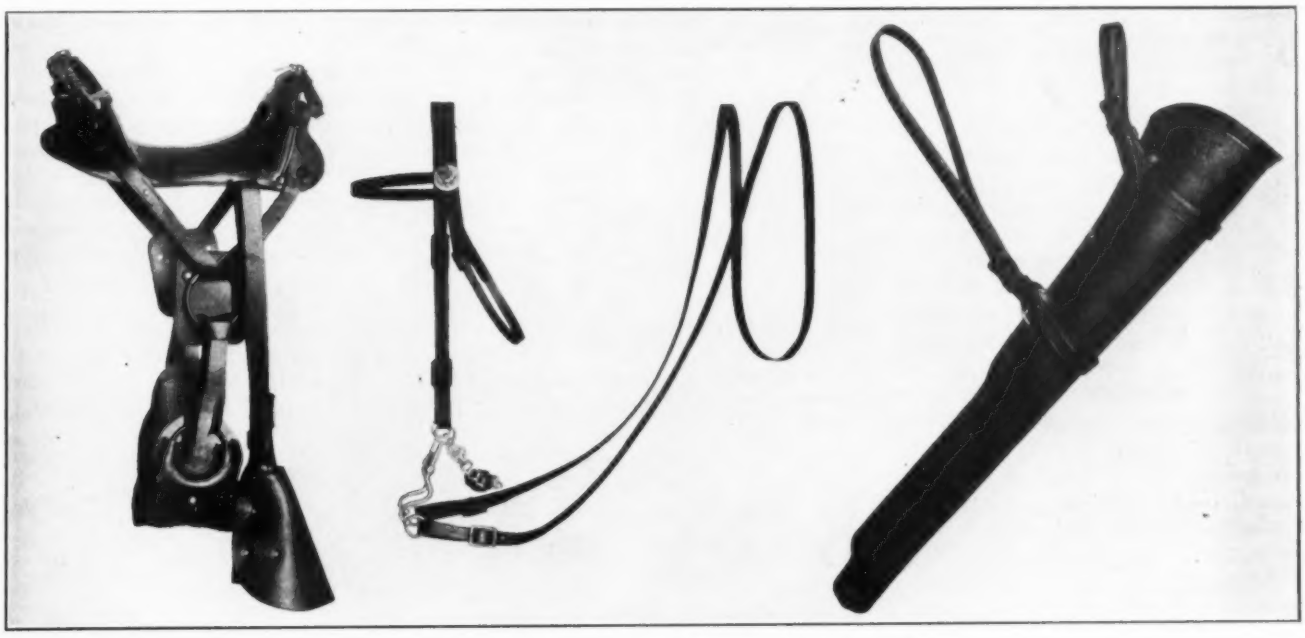


FIG. 28. SOME ILLUSTRATIONS OF HARNESS SHOP WORK.

FIG. 27. A TYPICAL VIEW IN THE HARNESS SHOP.

those in the divisor the point must be placed to the left. If the number of places in the divisor exceeds those in the dividend the point must be placed to the right.

To illustrate these, take the above given problems. Set the rule for problem 1. We find it comes under case 1. Regard the factors as whole numbers and apply the rule. Note that the sum of the integral places in the factors is 5.

$$332 \times 47 = 15600.$$

We have now the same result as if we had set down .332 and .0047 on paper and multiplied them but had not yet pointed off the result, and all that remains is to point off this result in the usual way, seven places to the left, giving our result .00156.

Problem 2 comes under case 2. Regarding the factors as whole numbers and applying the rule:

$$268 \times 25 = 6700.$$

Pointing off eight places to the left, we have for our result .000067.

We find that problem 3 comes under case 1. Regarding the terms as whole numbers and pointing off our quotient according to rule, and using for this our temporary decimal point:

$$199 \div 5 = 39'8.$$

The number of decimal places in the dividend exceeds those in the divisor by 4. Pointing off four places to the left, we have as our quotient .00398.

Problem 4 also comes under case 1. Regarding the terms as whole numbers and pointing off as before by the rule:

$$1475 \div 25 = 59'.$$

Here the number of decimal places in the divisor exceeds those in the dividend (just the reverse of conditions in problem 3) by 2. Pointing off two places to the right of our temporary point, we have as our quotient 5900.

Problem 5 comes under case 2. Regarding the terms as whole numbers in this we find that the number of integral places in the dividend is less than those in the divisor and the rule will not apply, so we increase the number in the dividend by annexing ciphers, calling these annexed ciphers significant figures and remembering in the final pointing off that these annexed ciphers count as so many decimal places just as if they were significant figures. Stating the problem as above directed and applying the rule:

$$900 \div 625 = 1'44.$$

Now the number of decimal places in the dividend exceeds those in the divisor by 3, so our quotient is .00144.

As multiplying or dividing both terms of a ratio by the same number does not alter its value, .09 ÷ 62.5 may be written 9 ÷ 6250, thus eliminating the decimal point entirely. This may sometimes be an advantage.

Very little on this matter is to be found in print and if there are quicker and more simple methods than these, I should be glad to see them.

Molding a Sheave With Sweep and Cores.

BY R. H. PALMER.

Fig. 1 shows the sheave. It is made in sizes from 4 feet diameter up, and the rim is finished for two wire ropes. Fig. 2 is the core box for the arms; Fig. 3, a segment for laying up the rim between the arms; Fig. 4, pattern for hubs; Fig. 5, the sweep for the bed, and Fig. 6 the sweep with the steel plate *D* for the face of the sheave and *E* for making the joint.

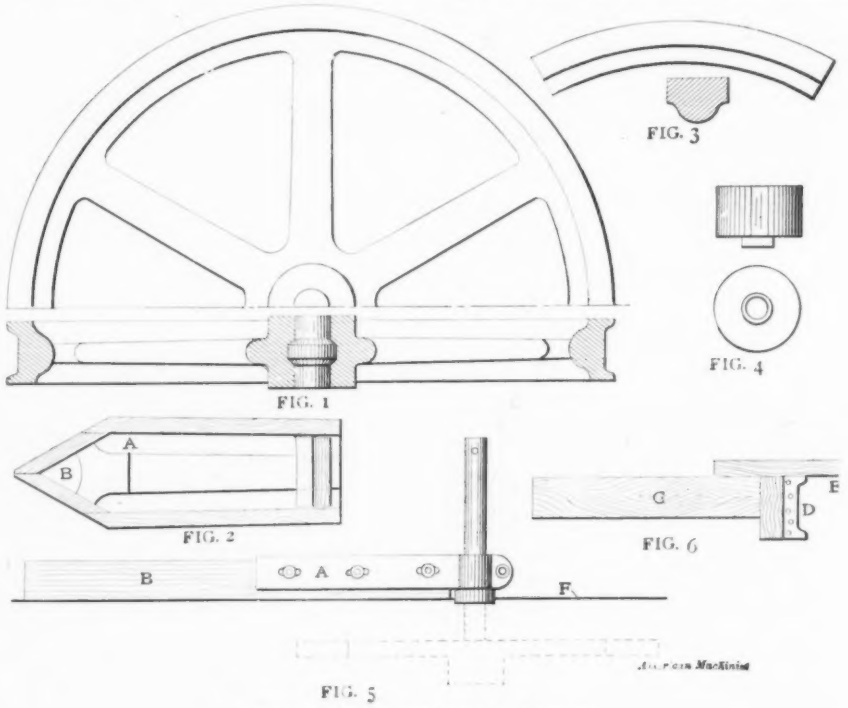
Sweep *B*, Fig. 5, is first used on finger *A* and the bed is swept to line *F*. The sweep is then removed, the parting is made and the cheek, Fig. 7, is placed in position, with the spindle in the center, and rapped down and staked at the corners. Sweep *C*, Fig. 6, is now bolted to finger *A*, raised to the desired hight, and the cheek, Fig. 7, is rammed up and trued by this sweep. When venting, the vents are brought to the outside near the joint of the cheek at about *G*. To finish the cheek below the point *H*, Fig. 8, the cheek is either left hanging in the crane while it is done, or it is horsed up, the sweep being removed from the finger before the cheek is hoisted off.

Finger *A*, Fig. 5, and the collar holding it up are removed and the hub, Fig. 4, having on it the core print, is slipped down on the spindle and bedded a little distance below the arm cores, as *J*, Fig. 8.

Cores *P*, Fig. 9, forming the arms, are spaced off and set around the hub. A piece of board *K* is placed on top of each, and they are clamped together as shown. As the hub pattern is not deep enough to make the hub, it is drawn up on the spindle high enough to allow pieces of wood thick enough to hold it up to the required hight above the cores to be placed under it. Sand is rammed between the arm cores and the segment *L*, Fig. 9. Spikes are used to carry the overhang. In cases where the segment is not long enough to cover the distance between the arm cores a line is marked with the sweep before the arm cores are set.

The spindle is now removed and the cope of a flask *R*, Fig. 9, is placed, and rods are driven down around it for guides. Gatesticks are set, on one side for a pouring gate and on the other for a riser, and this cope is rammed up and taken off, the hub is drawn out, and the mold finished; also the core is set and the cope is replaced.

The cheek *S*, Fig. 8, is then lowered around it and covering cores are placed over the rim, and around them are cinders over the vents. Paper is then laid over them and covered with sand, also cinders.



APPLIANCES FOR MOLDING A SHEAVE.

Two iron bars are then laid across the cope, the runner box is placed, gatesticks are put in and the runner is built.

On bars laid across the cope are placed pieces of pig iron; a run-off, or riser, is made up and a ball of clay on the end of a rod is placed over it. Pig iron is then laid over the covering cores, and the cinders are uncovered at point *V*, Fig. 10.

In pouring it is necessary that the mold be "watched up" closely, as there is a heavy head on it, and cut off quickly to avoid straining.

When setting the covering cores look out that the center is not crushed. It is better to keep the edge rather low. Vents inside the rim in Fig. 9 are to provide for escape of gas from overhang.

The sheave is churned on the hub, but as soon as the iron has run thru from the runner, the flow-off is banked and filled

with hot iron and fed a few minutes. Anyone not accustomed to covering molds with cores in this way will be surprised to see how quickly the iron will settle in a riser or rim, on account of there being so little head. When the casting is cool enough the rim is uncovered and the hub is dug out.

I do not recommend this way for smaller sheaves, but where few are wanted a molder accustomed to bedding and sweeping work will quickly make them in this way.

How Self-Hardening Steel Cuts Itself.

At page 970, Vol. 27, we described and illustrated the "grinder" built by the Armstrong Brothers Tool Company, Chicago, for cutting up bars of self-hardening tool steel. It will be remembered that for this purpose a very thin steel disk is used with a periferal speed of two or three miles a minute. It was stated that in the periphery of this disk particles of self-hardening steel were bedded, and these particles did the cutting, as diamonds are cut by diamond dust. This was rather incomplete information, but the specification of the patent recently published tells all that is lacking. The preparation of the edge of the disk consists, the specification says, in "rotating the disk for some time with its edge in contact with self-hardening steel, the cutting quality of the blade gradually developing, the initial effect being a mere abrasion of the material. After being thus treated for one or two hours the blade will cut into the material readily. While I am not prepared to suggest the details of the theory of the operation, I suppose it to be a fact that the rim of the saw becomes charged with minute particles of the self- or air-hardening steel and that these particles constitute the saw teeth or abrading agents. During the operation of cutting, grains of self-hardening steel are thrown out by the disk, the 'sawdust' remaining in the form of loose or separate grains clearly indicating the sawing to be accomplished by a true cutting action as distinguished from the fusion set up by so-called 'cold-sawing,' as practised heretofore."

Two Foundry Fires.

The following "typical fires" are reported in a recent issue of *Insurance Engineering:*

Schenectady, N. Y. November 2, 1904. A fire occurred on the first story of foundry building at 5.15 P. M. A 4-ton ladle, containing 3 tons of molten iron, was brought by a crane and one mold poured. When moving to the next one, the gearing pin, which holds the ladle in fixed position, was not in place and the ladle capsized, emptying the contents on the floor. Immediately the wooden patterns, flasks, and wooden shelving at that point took fire. So large a volume of heat rising to the roof opened fourteen sprinklers immediately, and a line of 2½-inch hose from a hydrant located inside the building at that point was used. After 15 minutes' duration the fire was extinguished. Forty-two large, live paterns were destroyed and twenty-one others were damaged. The man operating the electric crane was badly burned. Loss, $2,525.80.

Lynn, Mass. November 24, 1904. At 4.35 P. M. fire was discovered at the elevator in building No. 32. The elevator is run by an electric motor, with a controller on the car and a resistance box underneath. When the car was last used the switch on the controller was left so that the current continued thru the resistance box, or else some derangement of the controller closed the circuit thru some of the coils. The result was that the controller became overheated, and gradually brought the woodwork up to the ignition point. Fire extended over the under surface of the car, up thru the cracks in the floor, and along the guides. Two barrels on the car were ignited and considerably burned. The fire was discovered by an employee in the steel foundry, who saw the light of the flames thru the windows. He immediately notified the watchman, who called help, lighted up the building, and brought in a line of hose. On investigation it was found that a "Jumbo" sprinkler, located in the top of the elevator 33 feet above the car floor, had opened and completely extinguished the fire. This fire illustrates the necessity of so locating resistance boxes that, if they are overheated, they can do no damage. Loss, estimated as not exceeding $200.

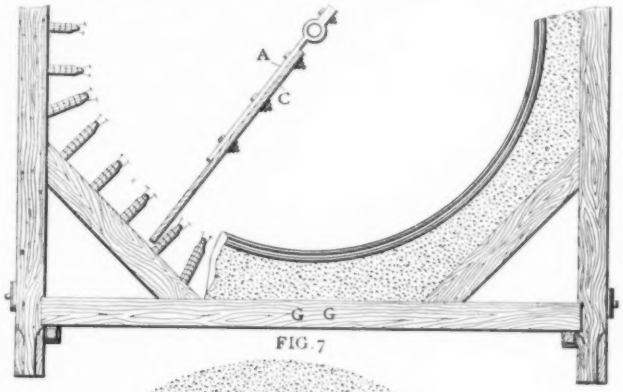


FIG. 7

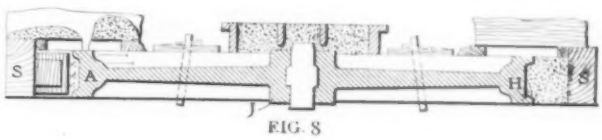


FIG. 8

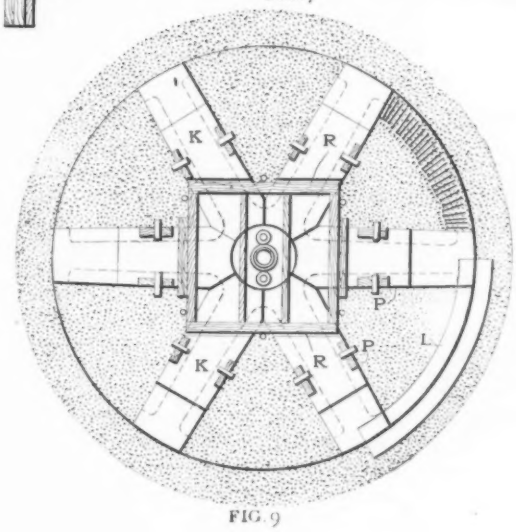


FIG. 9

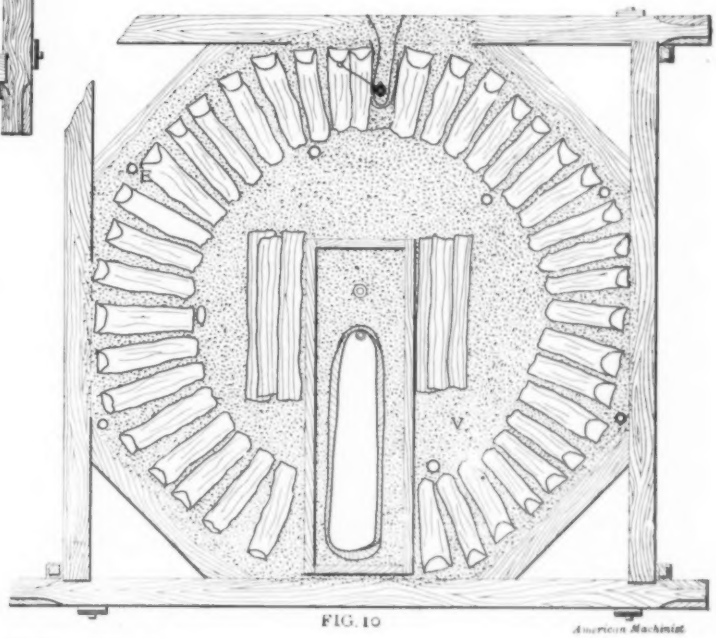


FIG. 10

American Machinist

MOLDING A SHEAVE.

Thread Tools and Gages—II.

BY A. NORMAN.

To cut a thread gage, as a general rule, is a small job, still there is quite an opportunity for improvement in methods of doing such work, and a few points will be mentioned here which may be of value in this connection.

LATHE ATTACHMENTS FOR FACILITATING THE CUTTING OF THREAD GAGES.

When the last cuts are taken on the thread, it must be within one ten-thousandth of an inch. For the reason a large disk, shown at *a*, Fig. 13, is of service. It should be as large as the lathe will permit; in this case it is 4½ inches in diameter and ½ inch wide on the face. It is turned out 3-16 inch from each side to make it light and neat in appearance. The disk is fastened to the cross-feed screw with a nurled screw, and is graduated in 250 divisions, and stamped on each side of the zero line from 0 to 125. Arm *b* is made the same radius at the top as the disk, and fits the hub of the cross-feed bearing. It is split at the end and clamped stationary with a machine screw. The graduations on top are ten in number, and occupy the same space as nine divisions on the disk, and for convenience in reading are stamped 0, 1, 2, 3, 4, 5, 6, 7, 8, 9, 0. Accordingly, when a line on the disk coincides with the first line of the vernier, the next two lines to the right differ from each other one-tenth of the length of a division on the disk, the next lines differ by two-tenths, etc. This design gives the thread chaser a positive position when feeding in for a finishing cut, while with the ordinary micrometer dial to feed in less than one-thousandth of an inch is a case of guesswork, and the consequences very likely are that the tool feeds in too far, the chaser begins to tear, and the thread gets rough and loses the correct shape and lead. A chaser should be filed on both sides the same angle as the thread, so it will start and end with a full thread, and not more than three threads should remain on the chaser; then it should be hardened in an open fire and drawn to a light straw.

Another good attachment for thread cutting is the stationary tool-post *c*, Fig. 13, which takes the ordinary style of chaser shown in Fig. 8. The post is fitted rather freely to the T-slot of the tool-block and clamped with two machine screws and two nuts *d*. A set-screw at the top and another at the side clamp the chaser, and after the tool-post has once been set square, the chaser will always be located properly after grinding. Where a tool-holder is used with a removable threading tool like that shown in Fig. 3, this tool-post is not required, as the chaser point will drop squarely into its seat after grinding.

MEASURING GAGES WHEN THREADING.

To know how deep to feed the chaser when cutting a screw, refer to the table given in Fig. 5. The best method for measuring the thread when finished is to measure in the thread angle by using an ordinary micrometer and wires of different diameters, as explained fully by Walter Cantelo at page 904, Vol. 26. To measure large threads, procure an ordinary micrometer head from any of the manufacturers of measuring instruments, make a C-shaped frame like an ordinary micrometer body, except that the anvil should be 1½ inches in diameter and the frame flat on the bottom, so it will stand upright; bore a hole in the top of the frame to fit the micrometer head, and at the same setting turn off the face of the anvil. Great care should be taken, after hardening the anvil, in grinding and lapping, that it is perfectly square with the micrometer stem.

POINTS IN GAGE CUTTING.

When cutting a screw plug it should be roughed out with a single-thread tool within .002 inch and then merely finished with a chaser so as to prolong the life of the chaser. It has been found when chasing that the lead of the lathe is not in all cases exactly the same with each cut. To make sure that the lead is perfect when the last cut is taken, go over the work three times with the chaser in exactly the same position, and by using a magnifying glass see whether the tool cuts any at either side of the thread; if not, then the lead is all right. The chaser should never be fed in more than .0003 inch with the first cuts, and .0001 inch with the last two cuts, to assure a smooth thread, and it is advisable when cutting to keep the screw well lubricated with lard oil, and for this purpose a square tin box and finger brush for the oil may be kept under the chaser.

A ring thread gage is made in a similar manner, but it is never finished with an inside chaser, except where such is required, where taps are not at hand. After being roughed out with the chaser, it is finished with two or three taps with a difference of two thousandths in diameter. On smaller ring gages inside chasers cannot be used, but a set of taps, six in number, are used, these varying in diameter, one from another, by from two to five thousandths.

LAPPING MACHINE FOR THREAD GAGES.

The lapping of plug and ring gages is the most important part of the whole job. A screw plug or ring gage should never be case-hardened; even if it is made of machinery steel and drawn to a blue, it is so brittle that the top of the thread breaks off in no time; even when fitting in lapping it has been found to break off. Lapping is very slow and tedious work when using an engine lathe, by moving the shifter to and fro; for that reason for lapping small thread gages a tapping machine was reconstructed as shown in Fig. 14. The spindle is extended about 5 inches with a left-hand screw *a* on the end. A cross-bar

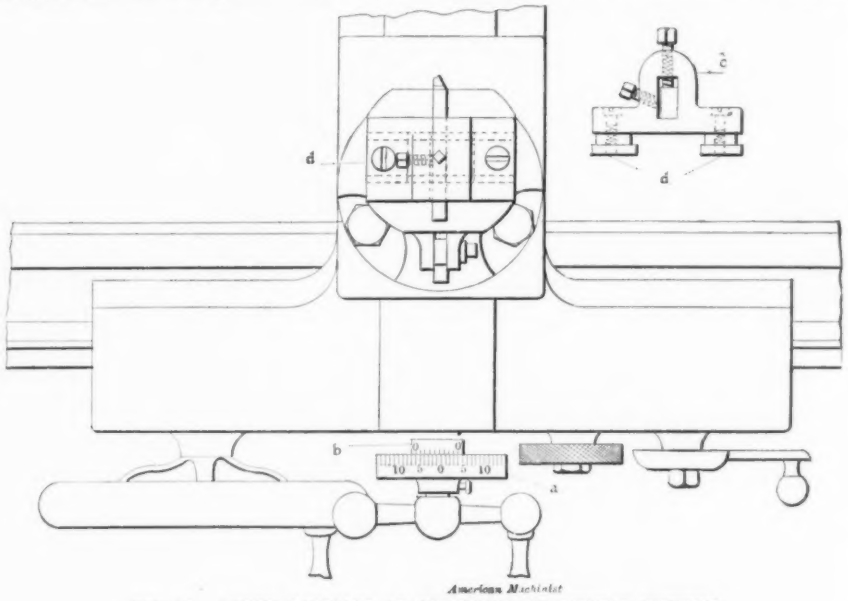


FIG. 13. LATHE CARRIAGE AS ARRANGED FOR THREAD CUTTING.

b is fastened on the end of the machine with two screws *c c*, two ½-inch holes are drilled thru the ends of the cross-bar to fit the two studs *d d* and these are held in position with nuts *e e*. A slot is milled in the end of each stud to fit the lever, and the latter is held at the end with a pin and attached loosely to a half-round box *f* by a screw *g*, the box being mounted freely between collars *h h*. By moving the handle to and fro the spindle is driven right and left. A large drill chuck is used to hold laps and screw plugs when lapping. With this machine the operator is in a sitting position, his left arm on the lever and the right hand on his work.

LAPPING GAGES AND THE USE OF TEST GAGES.

The first thing in lapping is to get the emery in good condition. Take a half-pint bottle, ⅛ of flour of emery, the rest of the bottle filled with machine oil; shake it

and stir it well, and let it stand for twenty minutes; all the heavy substance will then go to the bottom. Now take the bottle carefully and empty out half of its contents; this will be found to be very fine emery that never will make a scratch.

Test gages are used in lapping the ring gages, and a tap size plug is shown in Fig. 15. Right here is a little kink: To lap the plug round and straight, after it is ground never lap it across the surface slowly, but draw the lap back and forth

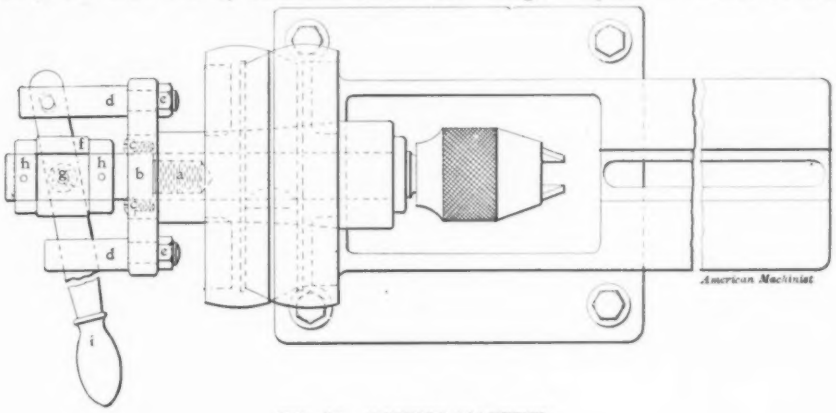


FIG. 14. LAPPING MACHINE.

an inch to a turn, as indicated by the lines on the plug; by so doing a perfectly straight and round surface is obtained. It will be found that a good many plugs are out of round because the lap has been drawn across the surface too slowly. When within .0001 inch of size, the lap and plug should be cleaned to remove all the emery and only machinery oil used; this will be found to give a very brilliant and shining surface. Another test plug used is shown in Fig. 16. This has only four threads, with a sharp or V-bottom, and measures one thousandth under size on the top or outside diameter, but must be exactly to size measured in the angle of the threads. Still another screw plug is used like that in Fig. 16 with a V-bottom and to measure the right size on top, but one thousandth under size in the thread angle. Then a regular screw plug is used that is standard size everywhere, and should be double the length of the ring gage. By having these test plugs an accurate external thread gage can be made; without them one cannot know where to lap when the gage doesn't come right.

KINKS IN FITTING GAGES.

If the ring gage happens to be lapped a trifle beyond the size, a very practical way to save it is to heat the gage to a light straw color and let it cool off slowly; it will then shrink sufficiently to allow the straw coating to be lapped off, and sometimes more, saving the gage, providing the lead is right. Sperm oil should be used when fitting thread gages, and not thick, heavy oil, as that is likely to cause false fitting. It has been found when a screw plug and ring fit fairly well in a horizontal position, that if raised to a perpendicular position they will fit so much easier, because the weight of the handle prevents true fitting in a horizontal position.

RING GAGE LAPS.

When lapping ring gages five laps of machine steel should be used to assure a perfect lead and these should be cut with the chaser, with .0001 inch difference in the diameter. There should be one straight lap for the top size and one lap with V-bottom, one-thousandth under on top of the thread, but right size measured in the thread angle; if it is found that the top of the thread in the ring gage is to be lapped, this lap will do it. An adjustable lap-holder, shown in Fig. 17, is useful. It is made of tool steel and spring tempered, and has a very thin slot in the center and one at each end of the lap cut to the center line. A taper screw in the center gives it a very fine adjustment and obviates hammering on the end of the lap, which upsets the end and sometimes changes the lead of the ring gage.

ALLOWANCES FOR LAPPING.

A screw plug can be measured all over with micrometer and wires by the method previously referred to, so that no test gages are required. In hardening such a plug it generally swells from two- to seven-tenths of a thousandth, according to the size of the plug, and it will be found that the extreme end swells from .0001 to .0003 more; so when cutting a screw plug .0003 is enough to allow for lapping. But in the ring gage .001 inch should be left for lapping, as both ends open out and the center shrinks.

LAPS FOR SCREW PLUGS.

Screw plug laps are made in a similar manner to the ring gage. Taps are made, one with V-top and flat bottom and to measure right on the thread sides or angle, and one tap with "V" or sharp bottom and top, and to measure .0001 under in the angle. Five laps are used with a difference of .0002 in diameters. For the top of the threads on the plug a straight lap is used to bring to finish size.

A lap-holder is shown in Fig. 18. This is made of machinery steel, nurled on the outside and bored to receive the lap rather freely. Cone-pointed screws hold the lap in place. When lapping large plugs, a short piece of wire screwed into the holder to act as a handle is found very convenient.

When only the bottom of the thread on the plug is to be lapped, a single thread lap will do the business. This is made of soft sheet metal, the width or thickness of the thread to be lapped, and tapped out the same as an ordinary lap. The sides are scraped off for clearance, and a slot is cut in the front end. The lap is held and adjusted with a light clamp, as in Fig. 19. This has proved very convenient, as it does not affect the lead, angle or the top of the thread.

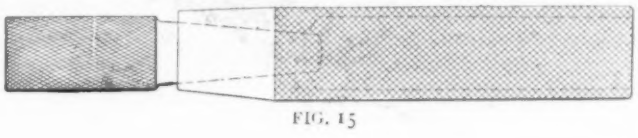


FIG. 15

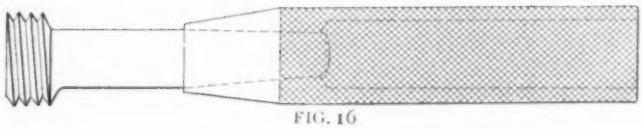


FIG. 16

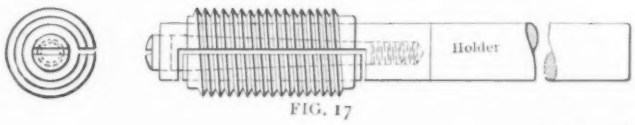


FIG. 17

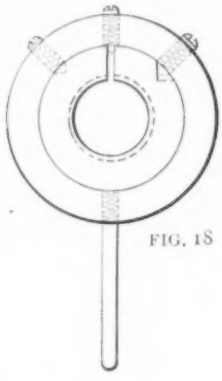


FIG. 18

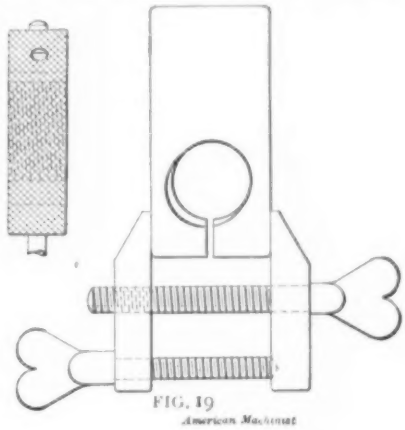


FIG. 19

LAPS AND TEST PLUGS.

To liquefy air it is necessary first to dry it.

A Modern French and an English Lathe.

A FRENCH LATHE.

The electrically operated lathe of French design shown in Fig. 1 was built for use with rapid cutting steel tools by the Société Alsacienne de Constructions Mécaniques, of Belfort and Grafenstaden. This lathe is operated by an electric motor on the headstock thru two five-step cones, worm and differential gearing for speed reduction. The rheostat is located at the side of the lathe and can be controlled by a lever mounted on each tool carriage. The greatest distance between centers of this lathe is 7 meters (23 feet). The diameter of the face-plate is 1,850 millimeters (72.8 inches), the bearing at the headstock being 350 millimeters (13.78 inches) in diameter, and its length 600 millimeters (23.6 inches). This lathe weighs 56,400 kilograms 56,400 kilograms (124,339 pounds) and occupies a space 12.5 meters (41 feet) long and 3.5 meters (11 feet 6 inches) wide.

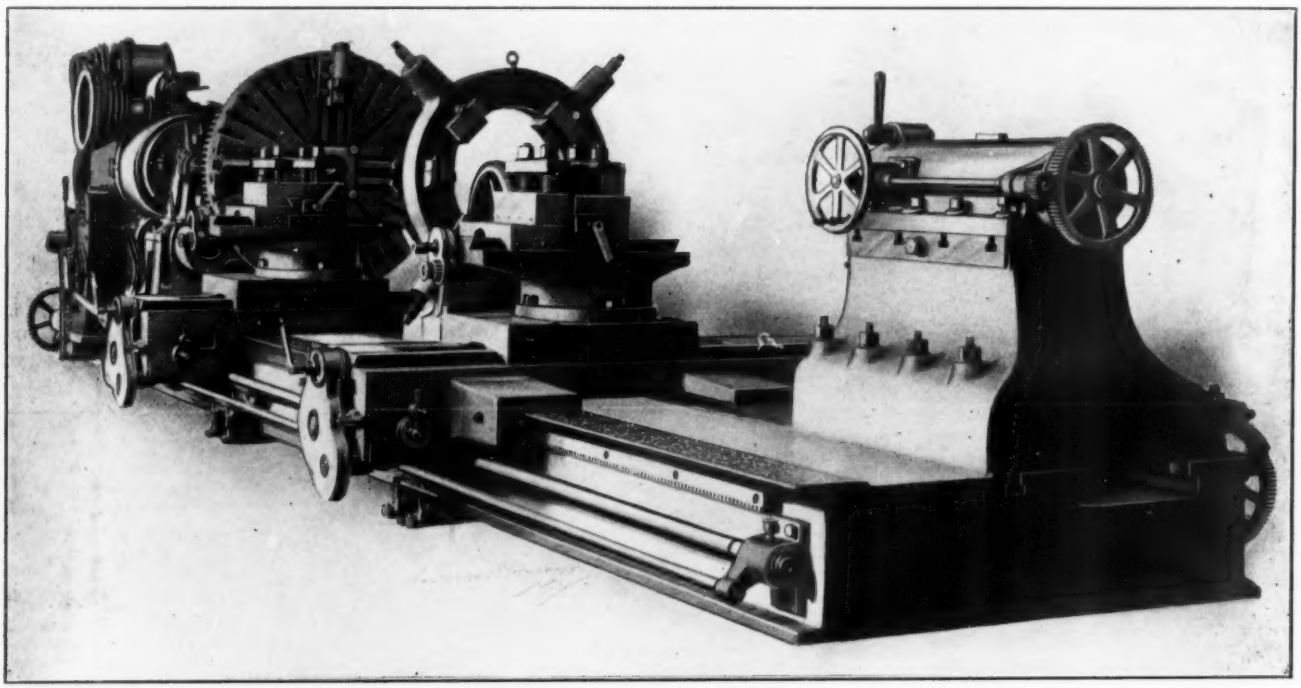


FIG. 1. A HEAVY ELECTRICALLY DRIVEN FRENCH LATHE.

AN ENGLISH COMBINATION LATHE.

Fig. 2 shows an English quadruple-geared special cylinder cover, flywheel and pulley turning lathe. It is built with pit and removable footstock interchangeable with a 30-inch shaping and slotting head. The present view shows the 4-foot 6-inch center lathe with the slotting head in place combined with a self-acting boring bar. This lathe was built at the Ancoats works, Manchester, by John Hetherington & Sons, Ltd. The base plate is of strong box pattern, well ribbed, 17 feet wide, 26 feet 3 inches long, and 2 feet deep. The base plate has a center opening or pit for swinging work of large diameter, fitted with removable cover plates, provided with slots planed from the solid on the top face. The pit admits work 12 feet in diameter when the cover plates are removed, and admits work in front of the face-plate over the base plate up to 8 feet in diameter. The slide beds are of box pattern, stayed with bars and planed on the top and bottom faces.

Each of these two beds is provided with the required number of stools for use when the beds are placed for sliding. Each bed is provided also with a compound slide-rest with full swivel and self-acting ratchet feed motions to the various slides worked from self-contained rocking shafts by means of adjustable weights and chains. The removable footstock is fitted with a sliding spindle of hard steel. The headstock is powerfully geared, with fifty changes of speed, thru single, two sets of double, one treble and one quadruple gear. It has five-step cone pulleys of large diameter, for wide belt of high velocity with a variable feed motion at the back end, giving two feeds per revolution of spindle thru the self-contained rocking shaft and ratchet feed wheel. The diameter of the geared face-plate is 9 feet, and the hight of the centers is 4 feet 6 inches, while the spindle front bearing measures 14 inches diameter and 21 inches long. The lathe admits between centers material 10 feet 10 inches long, and occupies a floor space 29 feet long by 20 feet wide.

In the place of the movable footstock it takes a 30-inch shaping or slotting head, as shown in the half-tone, for shaping keyways without removing the wheel, pulley or other object from the face-plate. It is mounted on the T-shaped bed, having a variable stroke with adjustable stops for various lengths. The maximum stroke of the ram is 2 feet 6 inches, and the smallest diameter hole the ram head will enter is 1 foot 4 inches.

The boring bar is 1 foot 6 inches diameter and 9 feet 3 inches long; the maximum feed traverse between stays is 4 feet. The bar, of gray iron, is fitted with a variable self-acting feed by change wheels and a steel square thread screw with gun metal nut, the cutter head and wearing bushes rotating in two massive standards. The total weight of the machine is more than 62 tons.

Comparative Tests of Common and High-Speed Drills.

We give below the results of some recent drilling tests at the works of the Rand Drill Company. As indicated by the reference letters, several brands of steel were used, but the names of these we are not at liberty to disclose, and, in fact, it would scarcely be fair to the makers of the steel to do this, as they were not represented at the tests, and might reasonably object to some of the conditions. The drills of common steel were driven at the same rate of speed as the high-speed drills, a condition that would not obtain in actual service; but the tests were made to compare the performance of the steels under identical conditions. Test No. 4 shows a low rate of feed because of lack of power in the machine used, and, in fact, it is the opinion of those making the tests that the high-speed drills would stand materially higher speeds and feeds were the machines sufficiently powerful to drive them. The tests, however, show remarkable efficiency of high-speed steel drills.

Test No. 1, Drill C:
Material—Gray iron.
Diameter of drill—15-16 inch.
Feed per minute—12 inches.
Revolutions per minute—264.
Depth of hole—2 inches.
Time per hole—10 seconds.
Total number of holes—12.
Condition—Good.

Test No. 2, Drill C:
Material—Gray iron.
Diameter of drill—1½ inches.
Feed per minute—6 inches.
Revolutions per minute—229.
Depth of hole—2 inches.
Time per hole—20 seconds.
Total number of holes—12.
Condition—Good.

Test No. 3, Drill C:
Material—Machine steel.
Diameter of drill—⅝ inch.
Feed per minute—10 inches.
Revolutions per minute—268.
Depth of holes—1½ inches.
Time per hole—9 seconds.
Common steel, drilled ¼ inch in 1 hole; condition, ruined.
High-speed steel, drilled 12 holes; condition, ruined.
Ratio—1 to 72.

Test No. 6:
Material—Very hard gray iron.
Analysis—Carbon, 3.336 per cent.; phosphorus, .682 per cent.; sulfur, .088 per cent.; silicon, 1.852 per cent.
Diameter of drill—11-16 inch.
Feed per minute—3 inches.
Revolutions per minute—300.
Depth of hole—3 inches.
Time per hole—1 minute.
Ratio of common to high-speed drill B—1 to 648.

Test No. 8:
Material—Steel.
Analysis—Carbon, .37 per cent.; phosphorus, .015 per cent.; manganese, .43 per cent.; tensile strength, 70,000 pounds; elastic limit, 50,000 pounds.
Diameter of drill—15-16 inch.
Feed per minute—3 inches.
Revolutions per minute—320.
Depth of hole—2 inches.
Time per hole—40 seconds.
Common steel, drilled ⅜ inch in 1 hole; condition, ruined.
High-speed steel, drilled 22 holes; condition, good.
Ratio of common to high-speed steel—1 to 117.

Test No. 9:

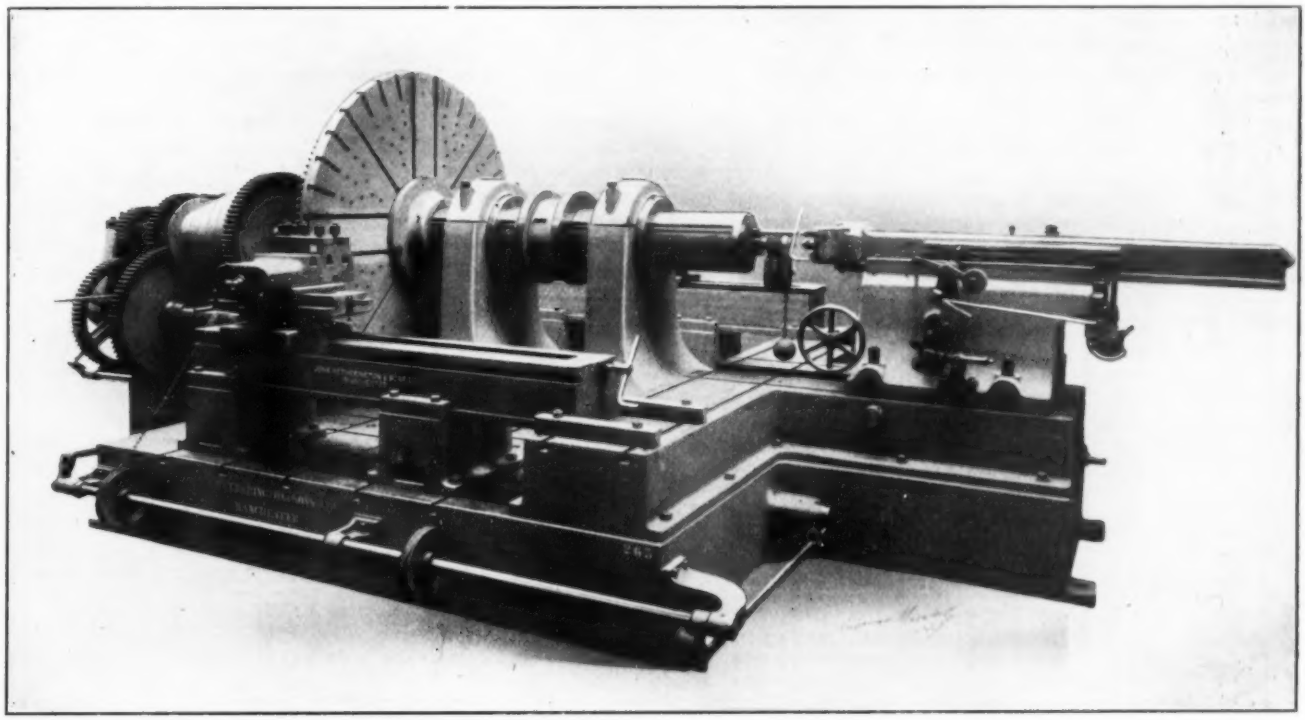


FIG. 2. LARGE SPECIAL ENGLISH COMBINATION LATHE, BORER AND SHAPER.

Diameter of drill—15-16 inch.
Feed per minute—4⅛ inches.
Revolutions per minute—264.
Depth of hole—3¼ inches.
Time per hole—50 seconds.
Total number of holes—6.
Condition—Good.

Test No. 4, Drill C:
Material—Machine steel.
Diameter of drill—1½ inches.
Feed per minute—2 1-16 inches.
Revolutions per minute—220.
Depth of hole—3¼ inches.
Time per hole—1 minute 25 seconds.
Total number of holes—6.
Condition—Good.

Test No. 5:
Material—Gray iron.
Analysis—Carbon, 3.222 per cent.; phosphorus, .751 per cent.; sulfur, .109 per cent.; silicon, 1.740 per cent.
High-speed steel drill, 10 holes; condition, dull.
Common steel drill not used.

Test No. 7:
Material—Gray iron.
Analysis—Carbon, 3.354 per cent.; phosphorus, .784 per cent.; sulfur, .071 per cent.; silicon, 2.097 per cent.
Diameter of drill—15-16 inch.
Feed per minute—18 inches.
Revolutions per minute—390.
Depth of hole—3 inches.
Time per hole—10 seconds.
Common steel, drilled ¼ inch in 1 hole.
High-speed steel drill A, drilled 11 holes; condition, dull.
High-speed steel drill B, drilled 54 holes; condition, good.
Ratio of common to high-speed drill A—1 to 132.

Material—Gray iron.
Analysis—Carbon, 3.372 per cent.; phosphorus, .714 per cent.; sulfur, .092 per cent.; silicon, 2.054 per cent.
Diameter of drill—½ inch.
Feed per minute—10 inches.
Revolutions per minute—390.
Depth of hole—2½ inches.
Time per hole—15 seconds.
Common steel, drilled 40 holes; condition, ruined.
High-speed steel, drill A, drilled 110 holes; condition, good.
High-speed steel, drill D, drilled 110 holes; condition, slightly dull.
High-speed steel, drill E, drilled 90 holes; drill broke thru carelessness; condition, good.
Ratio of common to high-speed—1 to 2¼.

Test No. 10:
Material—Steel.

Analysis—Carbon, .37 per cent.; phosphorus, .015 per cent.; manganese, .48 per cent.; tensile strength, 70,000 pounds; elastic limit, 50,000 pounds.
Diameter of drill—½ inch.
Feed per minute—3 inches.
Revolutions per minute—320.
Depth of hole—2 inches.
Time per hole—40 seconds.
Common steel, drilled 17 holes; condition, ruined.
High-speed steel, drill A, drilled 65 holes; condition, good.
High-speed steel, drill D, drilled 65 holes; condition, good.
High-speed steel, drill E, drilled 65 holes; condition, good.
Ratio of common steel to high-speed—1 to 3 8-10.

The large horizontal boring and milling machine exhibited by the Niles Tool Works at St. Louis, one of the largest of its kind in existence, has been purchased by The Great Lakes Engineering Works, Detroit.

The Strength of Gear Teeth Sustaining Shock.

BY CHEDDIE.

The article on gearing at page 1239, Vol. 27, brought to my mind some particulars I have on the same subject and I beg thru the medium of your paper to bring them to the notice of your readers.

The Lewis formula is correct for machine tools and kindred work, but where there is a great deal of shock and constant change of stresses, sometimes at very slow speed, as in lifting machinery, a great many makers of such machinery reduce the calculated stresses to counterbalance the excesses. The following tables give a general idea of the amounts by which these stresses are reduced. The Lewis formula is:

$$w = s\,p\,f\,y,$$

in which w = safe tooth load,
s = safe fiber stress,
p = circular pitch,
f = face of gear,
y = tooth factor,

his values of s being as in Table 1.

In the practise above referred to these stresses are reduced to the percentages given in Table 2.

The values of the stress allowed for gray iron, gun metal, cast steel and mild steel are in the ratios, gray iron 1, gun

Speed of Teeth in feet per minute	100 and under.	200	300	600	900	1,200	1,800	2,400
Gray Iron . . .	8,000	6,000	4,800	4,000	3,000	2,400	2,000	1,700
Steel	20,000	15,000	12,000	10,000	7,500	6,000	5,000	4,250

TABLE 1. VALUES OF STRESS ACCORDING TO LEWIS.

Speed of Teeth in feet per minute.	Percentages of Stress Allowed.
100 and under.	.6
100 to 200.	.7
200 to 2,400.	.8

TABLE 2. PERCENTAGE OF STRESS WITH HEAVY SHOCK.

Speed of Teeth in feet per minute	100 and under.	200	300	600	900	1,200	1,800	2,400
Gray Iron . . .	4,800	4,200	3,840	3,200	2,400	1,920	1,600	1,360
Gun Metal . .	7,200	6,300	5,760	4,800	3,600	2,880	2,400	2,040
Cast Steel . .	9,600	8,400	7,680	6,400	4,800	3,840	3,200	2,720
Mild Steel . .	12,000	10,500	9,600	8,000	6,000	4,800	4,000	3,400

TABLE 3. ABSOLUTE VALUES OF STRESS PERMITTED ON TEETH SUSTAINING SHOCK.

SPEED OF TEETH, FEET PER MIN.	MATERIAL	No. OF TEETH. 12	13	14	15	16	17	18	20	25	30	40	50	60	75	100	150	300	RACK
100 and under.	G. I.	536	560	576	600	615	640	673	720	776	815	874	896	913	928	945	961	976	992
	G. M.	804	840	864	900	922	960	1009	1080	1164	1222	1311	1344	1369	1392	1417	1441	1464	1488
	C. S.	1072	1120	1152	1200	1230	1280	1346	1440	1552	1630	1748	1792	1826	1856	1890	1922	1952	1984
	M. S.	1340	1400	1440	1500	1537	1600	1682	1800	1940	2037	2185	2240	2282	2320	2362	2402	2440	2480
100 to 200	G. I.	402	420	432	450	462	480	498	540	582	612	649	672	685	696	708	720	732	745
	G. M.	603	630	648	675	693	720	747	810	873	918	973	1008	1027	1044	1062	1080	1098	1117
	C. S.	804	840	864	900	924	960	996	1080	1164	1224	1298	1344	1370	1392	1416	1440	1464	1490
	M. S.	1005	1050	1080	1125	1155	1200	1245	1350	1455	1530	1622	1680	1712	1740	1770	1800	1830	1862
200 to 300	G. I.	321	336	346	360	369	384	398	432	465	490	518	538	548	557	567	576	586	596
	G. M.	480	504	519	540	553	576	597	648	697	735	777	807	822	835	850	864	879	894
	C. S.	642	672	692	720	738	768	796	864	930	980	1036	1076	1096	1114	1134	1152	1172	1192
	M. S.	800	840	865	900	922	960	995	1080	1162	1225	1295	1345	1370	1392	1417	1440	1465	1490
300 to 600	G. I.	268	280	288	300	308	320	332	360	388	408	432	448	467	464	472	480	488	496
	G. M.	402	420	432	450	462	480	498	540	582	612	648	672	700	696	708	720	732	744
	C. S.	536	560	576	600	616	640	664	720	776	816	864	896	934	928	944	960	976	992
	M. S.	670	700	720	750	770	800	830	900	970	1020	1080	1120	1167	1160	1180	1200	1220	1240
600 to 900	G. I.	201	210	216	225	231	240	249	270	291	306	324	336	342	348	352	360	366	372
	G. M.	300	315	324	337	346	360	373	405	436	459	486	504	513	522	528	540	549	558
	C. S.	402	420	432	450	462	480	498	540	582	612	648	672	684	696	704	720	732	744
	M. S.	500	525	540	562	577	600	622	675	727	765	810	840	855	870	880	900	915	930
900 to 1200	G. I.	161	168	173	180	185	192	199	216	232	244	259	269	274	278	282	288	292	298
	G. M.	240	252	259	270	277	288	298	324	348	366	388	403	411	417	423	432	438	447
	C. S.	322	336	346	360	370	384	398	432	464	488	518	538	548	556	564	576	582	596
	M. S.	402	420	432	450	462	480	497	540	580	610	647	672	685	695	705	720	728	745
1200 to 1800	G. I.	134	140	144	150	154	160	166	180	194	204	216	224	228	232	236	240	244	248
	G. M.	201	210	216	225	231	240	249	270	291	306	324	336	342	348	354	360	366	372
	C. S.	268	280	288	300	308	320	332	360	388	408	432	448	456	464	472	480	488	496
	M. S.	335	350	360	375	385	400	415	450	485	510	540	600	570	580	590	600	610	620
1800 to 2400	G. I.	114	119	122	127	131	136	141	153	165	173	184	190	194	197	200	204	207	211
	G. M.	171	178	183	190	196	204	211	229	247	259	276	285	291	295	300	306	310	316
	C. S.	228	238	244	254	262	272	282	306	330	346	368	380	388	394	400	408	414	422
	M. S.	285	297	305	317	327	340	352	382	412	432	460	475	485	492	500	510	517	527

G. I. = Gray Iron. G. M. = Gun Metal. C. S. = Cast Steel. M. S. = Mild Steel.

TABLE 6. VALUES OF SAFE TOOTH LOADS FOR GEARS 1 INCH PITCH AND 1 INCH FACE CALCULATED FROM THE ORIGINAL LEWIS FORMULA.

metal 1.5, cast steel 2 and mild steel 2.5, the absolute values being as in Table 3.

I also append Table 4 giving values of y for short teeth which are used for lifting machinery, Table 5 for converting diametral to circular pitches, Table 6 of safe tooth loads by the original Lewis formula, and Table 7 for safe loads by the reduced formula, Tables 6 and 7 being calculated for gears of 1 inch circular pitch and 1 inch face. The safe tooth loads for other pitches and faces will be increased or decreased proportionately by multiplying the value taken from the table of tooth loads for the given gear by the circular pitch and the face. The corresponding values for diametral pitches in circular pitches can be obtained from the conversion table.

No. of Teeth . .	12	13	14	15	16	17	18	20	25
y . .	.067	.070	.072	.075	.077	.080	.083	.090	.097
No. of Teeth . .	30	40	50	60	75	100	150	300	Rack
y . .	.102	.108	.112	.114	.116	.118	.120	.122	.124

TABLE 4. VALUES OF y FOR SHORT TEETH.

Echoes From the Oil Country—Acquired and Absorbed Knowledge.

It would seem that the hunter after knowledge has troubles and dangers of his own. He doesn't know what he wants until he has it, and then he doesn't know concerning some of it whether it will be any good to him, and only at the end of life would he be able to say whether it had been of any use to him or not.

I am not sure that this is what the quotation from Prof. Simon Newcomb means, but as I read it in a recent issue I could not help thinking that some kind of a separator is needed for each of us, for in our efforts to acquire knowledge if we try to grasp *all* that is within our reach in every direction, with the idea that it may all become useful at some time, we may soon have a fine mental junk yard. If the "true man of science" fills up his mind in that way he doesn't need to look for a job with me. Our conception of our "useful" knowledge is knowledge that we know enough to use, and the useful knowledge in general that is being worked for is the knowledge that has some bearing on business or pleasure within the range of our vision.

When I say "we" I mean us "practical" fellows who have to "do" something to hold our jobs. While some of us would like to know it all, most of us have had

Diametral Pitch.	Circular Pitch.	Diametral Pitch.	Circular Pitch.	Diametral Pitch.	Circular Pitch.
1	3.1416	5	.628	16	.196
1¼	2.513	5½	.571	17	.185
1½	2.094	6	.523	18	.174
1¾	1.795	7	.449	19	.165
2	1.571	8	.392	20	.157
2¼	1.396	9	.349	21	.149
2½	1.256	10	.314	22	.143
2¾	1.142	11	.285	23	.136
3	1.047	12	.261	24	.131
3½	.897	13	.241	25	.125
4	.785	14	.224		
4½	.698	15	.209		

TABLE 5. DIAMETRAL AND CIRCULAR PITCHES.

SPEED OF TEETH, FEET PER MIN.	MATERIAL	No. OF TEETH. 12	13	14	15	16	17	18	20	25	30	40	50	60	75	100	150	300	RACK
100 and under.	G. I.	321	336	346	360	369	384	398	432	465	490	518	538	548	557	567	576	586	596
	G. M.	481	454	519	540	553	576	597	648	697	735	777	807	822	835	850	864	879	894
	C. S.	642	672	692	720	738	768	796	864	930	980	1036	1076	1096	1114	1134	1152	1172	1192
	M. S.	802	790	865	900	922	960	995	1080	1162	1125	1295	1345	1370	1392	1417	1440	1465	1490
100 to 200	G. I.	281	294	302	315	323	336	348	378	407	428	454	470	479	488	496	505	513	521
	G. M.	421	441	453	472	484	504	522	567	610	642	681	705	718	732	744	757	769	781
	C. S.	562	588	604	630	646	672	696	756	814	856	908	940	958	976	992	1010	1026	1042
	M. S.	702	735	755	787	807	840	870	945	1017	1080	1135	1175	1197	1220	1240	1262	1282	1302
200 to 300	G. I.	257	268	276	288	295	308	318	336	372	392	415	430	338	445	453	461	468	476
	G. M.	385	402	414	432	442	462	577	504	558	588	622	645	507	667	679	691	702	714
	C. S.	514	536	552	576	590	616	636	672	744	784	830	860	676	890	906	922	936	952
	M. S.	642	670	690	720	737	770	795	840	930	980	1037	1075	845	1112	1132	1152	1170	1190
300 to 600	G. I.	214	224	230	240	246	256	266	288	310	326	346	358	365	372	378	384	391	397
	G. M.	321	336	345	360	369	384	399	432	465	489	519	537	547	553	567	576	586	595
	C. S.	428	448	460	480	492	512	532	576	620	652	692	716	730	744	756	768	782	794
	M. S.	535	560	575	600	615	640	665	720	775	815	865	895	912	925	945	960	977	992
600 to 900	G. I.	161	168	173	180	185	192	199	216	232	244	259	269	274	278	282	288	292	298
	G. M.	240	252	259	270	277	288	298	324	348	366	388	403	411	417	423	432	438	447
	C. S.	322	336	346	360	390	384	398	432	464	488	518	538	548	556	564	576	584	596
	M. S.	402	420	432	450	482	480	497	540	580	610	647	672	685	695	705	720	730	745
900 to 1200	G. I.	128	134	138	144	148	154	159	173	186	196	207	215	219	223	227	231	234	236
	G. M.	192	201	207	216	222	231	238	259	279	294	310	322	328	334	340	346	351	354
	C. S.	256	268	276	288	296	308	318	346	372	392	414	430	438	446	454	462	468	472
	M. S.	320	335	345	360	368	385	397	432	465	490	517	537	547	557	567	577	685	590
1200 to 1800	G. I.	107	112	115	120	123	128	133	144	155	163	173	179	182	186	189	192	195	198
	G. M.	160	168	172	180	184	192	199	216	232	244	259	268	273	279	283	288	292	297
	C. S.	214	224	230	240	246	256	266	288	310	326	346	358	364	372	378	384	390	396
	M. S.	267	280	287	300	307	320	332	360	387	407	432	447	455	465	472	480	287	495
1800 to 2400	G. I.	91	95	98	101	104	109	116	122	131	138	147	152	155	158	160	163	166	169
	G. M.	136	142	147	151	156	163	174	183	196	207	220	228	232	237	240	244	249	253
	C. S.	182	190	196	202	208	218	232	244	262	276	294	304	310	316	320	326	332	338
	M. S.	227	237	245	252	260	272	290	305	337	345	367	380	487	395	400	407	415	422

G. I. = Gray Iron. G. M. = Gun Metal. C. S. = Cast Steel. M. S. = Mild Steel.

TABLE 7. VALUES OF SAFE TOOTH LOADS FOR GEARS 1 INCH PITCH AND 1 INCH FACE CALCULATED FROM THE REDUCED LEWIS FORMULA USED FOR LIFTING MACHINERY.

The table calculated from the original Lewis formula has been added because I have not yet seen a table giving values for gun metal and cast steel.

so much of the conceit knocked out of us by circumstances that we are content to limit our diet, mentally, nearly to the substantials.

There is one avenue thru which knowledge comes which is not of our making and yet the knowledge that comes in that way is generally quite "useful." Did you ever think of the knowledge that you get in the way that a sponge gets water? It hits you because you are in the way, and you absorb it because you have a little room left.

"I got a corn sheller from you, and you warranted it, and now it is broken. What are you going to do about it?"

"I would like to know how it was broken before I answer that."

"I was just pulling on the handle when it broke, and I wasn't pulling very hard, either."

"From the looks of the place where it broke you must have been pulling sideways. You don't have to pull sideways to shell corn with it."

"No, but that handle didn't run true and I was trying to straighten it when the thing broke, and if your guarantee is any good—some of the folks out our way say it isn't—I want to know what you are going to do about it."

Persistent probing showed that the handle was bent by the "bull that got loose." Now, I didn't own the bull, and didn't intend to guarantee against him.

"I want you to come and take this corn sheller back," reads a letter. "You said it was the easiest way in the world to shell corn and I find it is lots harder work than it was to rub the ears together." Five bushels in one hour or one bushel in five hours seems to be all the same to this man.

"You said you would furnish me a machine finished in a first-class manner and you didn't do it. Get me a machine here at once that has a polished hand wheel, and hopper, and nickel-plated measure to catch the corn in, and it should set on a piece of polished rosewood instead of on a chunk of oak." Poor fellow, he evidently intended to buy a parlor ornament, like the $1,200 farm wagon the Studebakers had on exhibition at St. Louis, and didn't say so soon enough.

"I think you should repair this machine without cost to me, for my hired man says you never told him that it had to be oiled." Maybe I did forget that, and as like as not I didn't tell him to stop turning the crank when the corn was all shelled. How very careless in me, to be sure.

"I heard that you give the dealers ten cents on the dollar for selling your corn shellers for you, and then you give them some more for paying their bills. I sold this one to myself for you, and my money is just as good as anyone else's is, and I'm not going to let you or anyone else gouge me."

It took hard work to extract the order, tho, and the bill is now several months old and not paid yet.

"I am very much surprised and grieved to receive such a letter as I received from you. I bought the machine only to accommodate you, and now you act as tho you thought I was not going to pay for it. I don't see how you can be so inconsiderate when I have stood up for you as I have."

Friends are found in unexpected ways sometimes.

"I am ready to accept this machine and pay for it just as soon as you come and prove that it is all right. I do not know that there is anything wrong with it, but I am not a mechanic, and so I must insist that you come and demonstrate that there is not before I finally accept it. I have also been told that you do not use open-hearth acid charcoal iron, made by the Bessemer process, in these machines as you should do. I trust that I have been misinformed in this matter. You claim to use only the very best material in the production of these machines, and I would feel very much disappointed to have my confidence in you shaken."

All knowledge is *useful, if* it is in the right place.

"Don't send me the machine I ordered. I can get one that weighs four pounds more for seventeen cents less money. I had an idea all along that you were high, and now I know it. I can buy a plow for six cents a pound, and a wagon for four and a half, and you don't need to think that I will pay you nearly nine cents a pound for your sheller, especially when I can buy one that is bigger for less money. The paint on it is lots redder than that which you put on, and it has green and black stripes on it, too, while yours is only a sort of plain brick color without any stripes on it."

I certainly have some things to learn yet right here at home, and it seems as if I had better learn some of them quickly, too.

"I have been looking over the corn sheller that you make. I will order one if you will arrange it so that I can use it as a cider press, too, and while you are at it you might as well make it so that it will cut up pumpkins. These attachments will add very much to the popularity of the machines, and so will be of much value to you, and I think I should receive something for my invention. If you let me have the machine with the improvements on it for half the price you are asking for the regular ones, I will let it go at that, because I want to help you along."

Had he sent along plans showing how to apply said attachments, and then let me into the secret of putting them on, and of making them, without increasing the cost of the machine, I would have considered his proposition. There are some orders that I never expect to get even for as good a thing as I know this corn sheller to be.

"I am sending you a sprocket wheel that I want you to put on the shaft where the hand-wheel goes. If the hole is not the right size so that either the hand-wheel or the sprocket wheel can be used, change it to suit. I am going to try to fasten this sheller on to the wagon box and run it with a chain from the wagon wheel. If it works as I think it will, it will shell the corn right from the stalk, and so save time and handling. I would like to have the spout changed so that with the shaft standing parallel with the wagon axle and the sprocket on the outside the shelled corn will deliver into the wagon box. If this thing works I expect to use four shellers to each wagon, one to each wheel. If you can give me any information as to how fast I can safely run your machine, and at what speed I can get the greatest amount of work out of it, it will be doing me a great favor. If your experience can suggest any changes on the machine that will likely make it any better for the use I intend to put it to, please put them on at my expense, and also charge me with any extra cost you may be to in putting on the sprocket wheel, and in changing the spout."

All the information and all the mechanical skill around the establishment is at the service of that man whether his idea is any good or not. He is willing to pay for everything he gets, and I am willing to bet that he generally gets good measure, and doesn't have to fight for it, either.

I have gone thru the country for years, and yet there are birds that I did not know of which still are quite common. I am surprised to find how many trees a woodsman can point out which are entirely strange to me and are common to this section. Even in my backyard a botanist can find weeds and grasses that I never saw, and if I never saw them what better proof could be wanted that they do not grow there, for isn't this my backyard?

Perhaps strange things happen in corn-sheller shops, just as strange weeds grow in my backyard, but ask your neighbor who makes some other kind of "corn shellers" and he will tell you that I have only told of some of the types that are common to all sections, and likely he will tell you of a lot more.

It may be that if some kinds were very common the effect would not be for the best good of all concerned. Think of the effect of a regular diet of this kind:

"Dear sir: I write this to let you know that the corn sheller that you sold me is a world beater. It has never cost me a cent for repairs nor given me trouble of any kind. I want another one just like it and enclose the money for the same. I feel that you do not charge enough for them, but to try to even things up I send you some orders from some of my neighbors. I don't want any commission on these orders, and I feel that I am doing good to my own section in having folks use them. I will stand good for any orders that come thru me. Be sure and stop and have dinner with me whenever

you are in this part of the country, and bring your wife with you," etc.

Or of this one: "I know that you make good machines, but you never made a better one than the one you sold to me seven years ago. It has shelled more corn than any two of my neighbors raise, and is as good to-day as it was when I first got it. I would not trade it for a new one even if I was offered 'boot.' I can run it with one hand, while lots of other makes take both hands to keep them going, and then they don't shell as much corn in a year as I do. It never yet refused to shell when I asked it to, and turned the crank."

Do you wonder why the boys are all eating apples? A man stuck his head in a while ago and remarked: "There's some apples out here in my wagon in a bag, and they are yours if you can carry them in. I just brought them along so that you would not forget me. I feel like doing something to you to even it up on that machine you sold me. It works so well that I have to hunt an excuse now to bring me to the shop." It takes more apples than can be gotten into a two-bushel grain bag to run a bluff with us, and so the boys get a treat.

Whatever my opinion may be as to the value of the knowledge that we set out deliberately to learn, there is one thing quite sure and that is that the knowledge that we acquire in spite of ourselves is nearly always of the useful variety.

W. OSBORNE.

Simple Rotary Speed Indicator.

A speed indicator, very simple in principle, depending on the force of a permanent magnet, has been described by Otto Schulze to the Elsass-Lothringer branch of the Association of German Engineers, and is briefly described in the organ of that body. While apparently intended primarily for automobile purposes, it would seem to be possible of a more extended utility.

A metal disk is turned against the force of a spring by a rotating magnet whose velocity corresponds to that which is to be measured. The magnet revolves the disk when the spring is not in play. The difference between the moments due to the magnet and the spring is indicated by a needle attached to the disk. The magnets have shown a notable constancy of strength during more than two years of experiments, but if their power falls off it can be restored, or compensation can be made by changing the distance between magnet and disk. The appliance is generally worked by a flexible shaft in connection with the driving mechanism of the vehicle. Arrangements for measuring the distance traversed are used in connection with this speed indicator. There is also a device for registering the number of hours of operation of gearing assumed to run at constant speed.

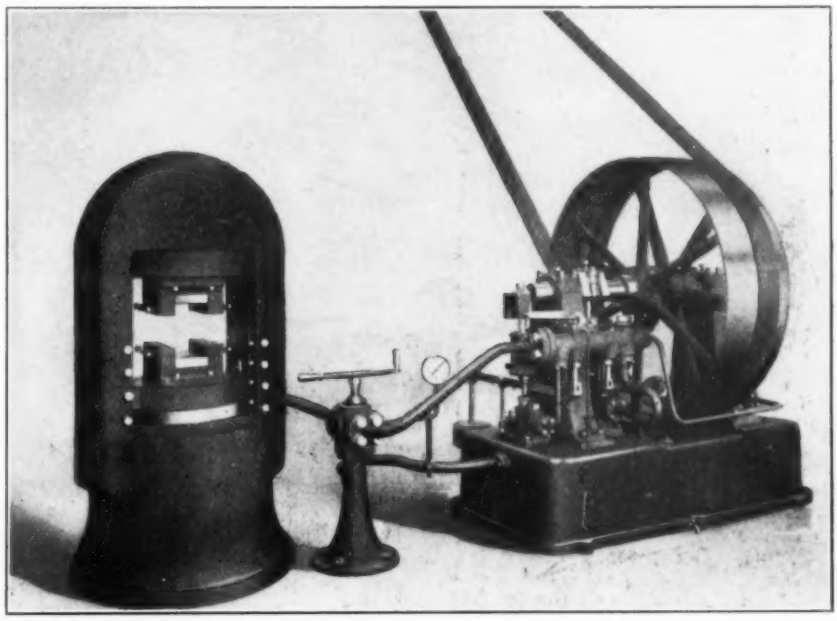
A Hydraulic Coining Press and Pump.

BY DR. ALFRED GRADENWITZ.

The largest power presses in use for coining purposes are not altogether satisfactory as to the force exerted, multiple pressing and annealing being necessary to obtain sufficient sharpness of detail. On account of the constant danger of breakage and the premature wear of the costly dies due to shock, some other suitable device has been desired.

The hydraulic coining and pressing outfit brought out by the firm of Fr. Mönkemöller & Cie., Bonn, Germany, seems to be very satisfactory, producing enormous pressures with relatively small and inexpensive apparatus.

The following will give an idea of the power of this press: A medal 90 millimeters (3.54 inches) in diameter, with very deep engraving on both sides, is "struck" with a single or a double pressing, and



HYDRAULIC COINING PRESS AND PUMP.

with at most one annealing, the dies being exposed to much less wear and tear than in the case of power presses, the latter, moreover, requiring twelve to fifteen operations with annealing after each. The sinking of the steel matrices also is made in one compression without any annealing, the steel being considerably improved at the same time.

The entire outfit, press, pump and controlling apparatus, is shown in the halftone. The body of the press is a steel casting. The moving table is accurately guided by long, adjustable slides. The compressing pump, being essential to the satisfactory working of the whole plant, has been given special attention. The pumps will work in the smaller sizes to maximum pressures of 350 atmospheres and in larger sizes to 500 atmospheres. In all cases there are three pistons of different diameters, the larger ones being thrown out one after the other as the resistance increases, so that only the smallest piston is employed for slow work and for the highest pressures and final compression. Safety valves are provided for each cylinder and pressures of any magnitude may be kept on for any desired length of time. The pump is driven either by belt thru tight and loose pulleys or by a direct coupled electromoter. The gray-iron bed serves as a tank for the return water.

The Thousand-and-more Per Cent. Tax on Alcohol.

According to reports from Washington there is little chance of securing the passage at this session of the bill which came over from the last session removing the internal revenue tax from alcohol of not less than 160 per cent. proof when "denaturized," or mixed with certain prescribed substances to make it unfit for use in any kind of beverage. There is hardly any material that has so many and such important uses in manufacturing processes as alcohol. It can be made in this country and sold at a profit for 15 cents a gallon, but under the requirements of the internal revenue law the tax upon it amounts to $2.07, preventing its use except to a very limited extent and repressing the industries that might be developed by its free employment.

Why, then, is there any difficulty in getting the tax removed and giving our industries and trade the benefit of so valuable a material? The only argument now presented is that it might somewhat reduce the revenue of the government, and that cannot be permitted until there is a general revision of the system. It is doubtful whether it would reduce the revenues at all, and it is not certain that it would not increase them. The tax upon distilled liquors and upon alcohol in its natural state would be in nowise affected

and their use would be little, if any, diminished. Only that of pure alcohol could be. The uses to which it would be applied would be mostly new or extensions of old ones. The untaxed article would be almost wholly an addition to the present production of alcohol, and it would induce the increased use of many other materials, some of which pay a tax to the government. Besides, any considerable increase of industrial production in varied manufactures would lead to larger consumption of many things, domestic and imported, and thereby contribute indirectly to the public revenues. There is no room for doubt as to the benefit of removing the tax from denaturized alcohol, and it is unfortunate that there should be any hesitation in Congress about an act so obviously desirable.—*Journal of Commerce*, New York.

The Mechanical Engineer, London, states that altho the estimated number of power-driven spindles in the textile industry is now estimated at 112 millions, this number is still far exceeded by that of hand-driven spindles. Of the power-driven spindles, 48 millions are in Great Britain and 18 millions in the United States. China has 1¼ millions of power-driven spindles, but has also 100 millions operated by hand. There are also 60 millions of hand spindles in India. Japan for each power-driven spindle has five driven by hand.

Hammacher, Schlemmer & Co.'s New Store.

BY E. A. SUVERKROP.

I had a look over the new building occupied by Hammacher, Schlemmer & Co., the other day. This building, of combination stone and brick, is situated at Fourth avenue and Thirteenth street, New York. It is seven stories high, with 75 feet frontage on Fourth avenue, and has a 40-foot "L" with an entrance on Thirteenth street.

The seven floors are excellently lighted and aggregate about 40,000 square feet of floor space. The interior fittings are of oak and mahogany, designed and built especially to accommodate the enormous stock of tools and hardware. The first floor, shown in the illustration, is devoted to retail business. Here are numerous show cases with fine displays of samples of an almost endless variety of hardware and tool specialties. Two small rooms are partitioned off on this floor. In the one are samples of household hardware, conveniently arranged so that one may in a very short space of time see all the newest styles of hardware for a house, from the knocker for the front door to a latch for the back gate. The other room is laid out as a sort of amateur's paradise, with benches, tools, a lathe, scroll saws, etc.

The stock not displayed in show cases is kept in sliding boxes and drawers arranged around the walls, counters, etc. A sample of the contents of each drawer is secured to the front of it, and on the side of the drawer is a printed label designating the floor upon which the surplus stock of the article contained in that particular drawer is kept. No looking up books, lists, etc., or asking questions; right on the side of each drawer is marked the location of the over stock. As there are speaking tubes, telephones and two dumb-waiters connected with each floor, there is but little loss of time in filling orders from the over stock.

The second floor is occupied by the offices. On the third floor are the receiving and shipping departments. All goods, except those shipped direct from factory to consumer, go to this floor, from which they are dispatched to the floor where such goods are stored. On this floor all orders shipped from the house are made up. Here are a large number of drawers of various sizes; each one of these drawers has a number affixed. If on filling an order the shipping clerk finds that there are certain goods called for which are not in stock, he affixes a number to the order, corresponding to a number on one of these drawers. Into this drawer are put the items which are in stock, and here they remain until such time as the order can be filled in its entirety, provided, of course, that the order is to be held for total shipment. Once the goods are put in the drawer they are considered the property of the customer, and

HAMMACHER, SCHLEMMER & CO. FIRST FLOOR DEVOTED TO RETAIL TRADE.

the shipping clerks are not allowed to go around these incomplete orders and select goods which have previously been assigned to customers, in order to satisfy the demands of those coming later.

The business of Hammacher, Schlemmer & Co. is almost entirely with manufacturers and consumers direct. They do not seek business with dealers, except on certain specialties which they control. Their lines cover about 10,000 different items, and these they endeavor to keep in stock at all times. Their stock covers a vast variety of hardware, tools and supplies for all trades. The salesmen of the concern travel throughout the United States east of the Mississippi, and cover a large part of Canada as well.

I saw a variety of supplies, from set-screws for shaft collars to shark skins used by piano makers in lieu of sand-paper, and even then I didn't see all their stock.

Unlike the London omnibus companies, the Paris General Omnibus Company has shown itself incapable to withstand the competition of the Metropolitan Railway. In order to ameliorate the stultified condition of the company's operations, a committee has been sitting for some months, which proposes to reorganize omnibus monopoly, and the renewal of the concession for a period of thirty years, subject to several important new conditions, has been recommended. The chief of these is that all horse-drawn omnibuses are to be replaced by mechanically propelled vehicles.—*The Engineer.*

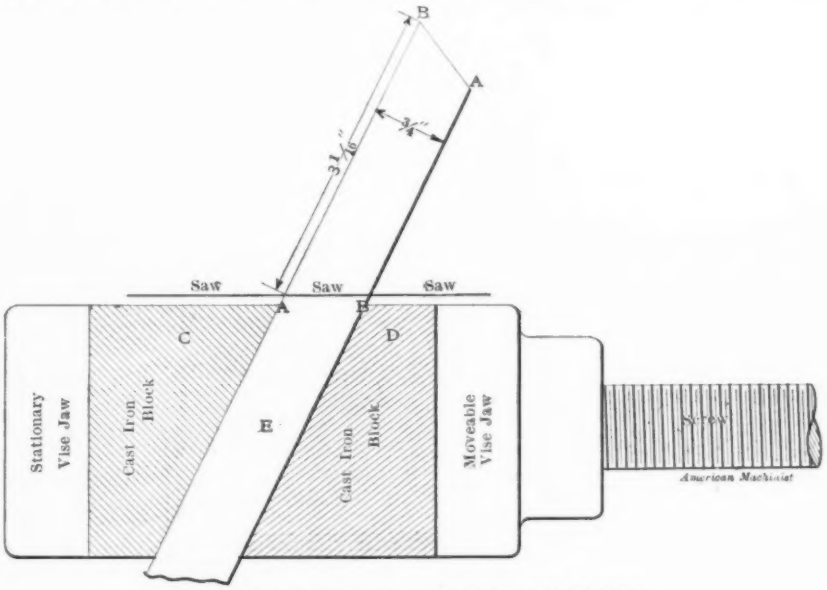
At Despatch, N. Y., a piano factory is being built which is to be of fireproof construction throughout. Walls, floors, roofs, partition walls, beams, columns and stairs are to be of reinforced concrete. The windows, which will form about 70 per cent. of the wall surfaces, are to be glazed with wire-glass in metal frames and sash.

Letters to the Editor.

The Power Hack-saw as a Time Saver.

In machining die blanks used on a roll threading machine for threading small brass screws, we have found the idea shown in the illustration to be not only a time-saver but a steel-saver as well. The die blanks are beveled at each end, as shown at *X*, which is a die blank, 3 1-16x 1x¾ inch, to fit in the shoes of the machine, by which they are held when in use.

The idea, as shown in the illustration, is to saw the blanks at the required angle on the power hack-saw, allowing 1-16 inch for finishing. This is done by the aid of the gray-iron blocks *C* and *D*. After each blank is sawed off the bar *E* is turned bottom edge up and another blank is cut off, and so on until the bar is used up.



THE POWER HACK-SAW CUTTING-OFF DIE BLANKS.

The blocks *C* and *D* are made the same hight as the vise, and are used on other jobs besides the one referred to.

C. F. EMERSON.

"Train a Child up in the Way He Should go."

My education in one direction was sadly neglected. Both my father and my mother had decided indications of business ability which I by heredity ought to have had, too. But in this particular line of development I was never encouraged. The consequence was that when I did start in business for myself (with the reputation of being a really good machinist and with a first-class education) I found that people who did not know the work nearly as well as I, either theoretically or practically, could *do* me with a finished ease that I was compelled to admire. After several years of hard knocks I eventually ceased wearing my heart upon my sleeve, and stopped believing everything that was told me, when I found that I could make more money with considerably less trouble than at the first. My business has been the making of special machinery, and in this line I have been fairly successful.

When my boys got big enough to understand I was always glad to have them come to the shop. One little corner of the shop was theirs. In it they could do what they pleased, providing it was kept fairly tidy. When the oldest boy got big enough I showed him how to make cannons and other metal toys on the lathe, how to temper tools, etc. I also let him do regular work for the shop, such as cutting off stock in the power hack saw. Whenever he did shop work he was under the jurisdiction of the foreman and earned pay proportionate with the amount and quality of the work produced. At fifteen he has a better all-around knowledge of the use of tools than many men I have known who have worked that length of time in a machine shop.

Often at home in the evening, when I had an order for a special machine, I would take my boy into my confidence, tell him what the machine was expected to do, also how the work was done at the time. If by hand or machine, explaining the different operations, asking him to try and devise a machine that would do the work. This trained the boy's mind to reason the different necessary movements out.

Sometimes he was of considerable help to me, he having one advantage, that of seeing a thing from the outsider's point of view, practically unhampered by mechanical knowledge.

We had an order for a printing press to print small hollow cylinders of wood. These little cylinders were sheaths for wire corkscrews. They were neither round nor parallel. Being out of round was no objection with the mechanism we intended using, but the ridges in them did make a very great difference. The wood was thin, therefore we could not use sufficient pressure to force the type into the wood and thus compensate for the irregularities.

My boy came in one Saturday when the machine was completed and we were trying it. After watching us for a while he said, "Father, I think I know how to make it print all over the irregularities." "Well, if you do, let's hear how." "I would put a piece of thin sheet steel under the type, and under the steel a piece of very springy rubber. I would not lock up the type in the chase tight, but just so that it could slide up and down and adjust itself to the irregularity in the cylinders."

We tried his idea, using a piece of thin rolled steel .003 inch thick with about 1-16 inch of soft rubber sheet under it. This arrangement worked well, so I called my boy into the office and wrote out a bill of sale wherein Dixie junior agreed to sell to the firm of Dixie & Yank his idea of a flexible bed for type, for the sum of five dollars. "There," said I, "read that over and if it suits you sign it and I'll give you a five-dollar bill. If it doesn't suit you

we will steal your idea anyhow and you won't get a cent." "But, father, that isn't fair to talk that way." "No, my son, it is not, but that's the way your father has been treated more than once and you had better learn now how you are likely to be treated by outsiders when you are in business, and protect yourself against the sharks I am at present impersonating." I then explained to him about patent protection, and how by making a sketch and having it witnessed it would be a fair kind of protection for two years.

Some months after this another machine was being built. I happened to mention at home some trouble I was having with the model. Next day, Saturday, he was down at the shop and took great interest in the new machine and its shortcomings, so much so indeed that I was compelled to chase him away. Next day (Sunday) he came to me and said, "Father, a contract made on Sunday is no good, is it?" I told him that some kinds of contracts made on a Sunday were not valid. "Then I'll wait till to-morrow." "What kind of a contract do you want to make?" "Oh, I know how to make that machine in the shop work and I wanted to make a contract with you." "What have you got? Let me see how you are going to make it work?" "No, if I show it to you, you will tell me to take so much or you will steal it. Now I want you to agree to give me ten dollars if you use it." The agreement was subsequently drawn up on these lines and I gladly paid ten dollars, not so much for the idea, as we used only a part of it, but for his having remembered his first lesson. DIXIE.

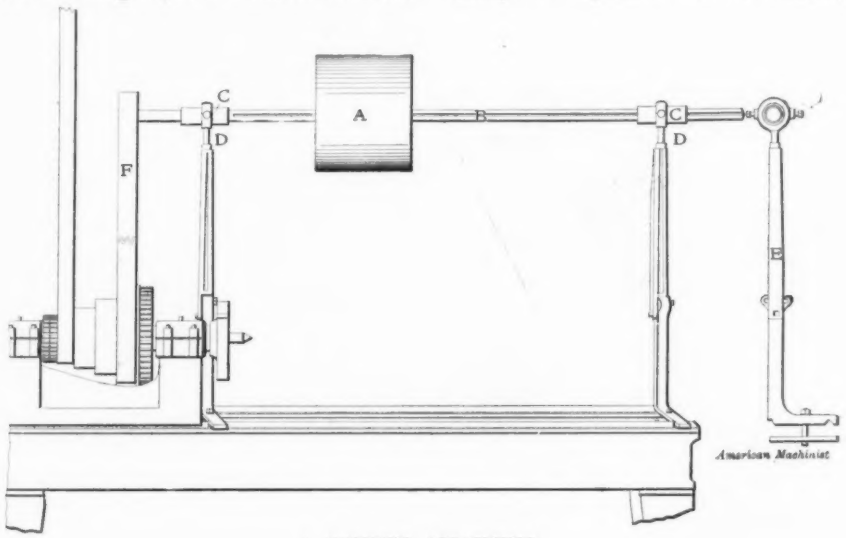
Halving Mixed Numbers in Dimensions on Drawings.

At page 60 L. A. M. gives a short method of halving mixed numbers. Now, I do not think he means to give the impression that he would turn out drawings with such dimensions as $\frac{1}{16}\frac{3}{8}$ inch on them. Many machinists with such a dimension would have quite a time figuring out the value of it. For my part I always try to give dimensions in as simple a form as possible. Now, in giving this special size I should be governed by two things: first, whether micrometers were used in the shop or not, and if they were I should give it as either 0.945 or 0.946 inch, or, if the work was such as required such extreme refinement, I should give it exact, 0.9453125. I suppose it is common knowledge among men using the "mikes" in reading a measurement, or, rather, reading the table of equivalents, to divide by 10 mentally by reading the last figure as $\frac{1}{10}$ of $\frac{1}{1000}$, as, for instance, the table gives $\frac{1}{16} = .0625$ inch, which of course reads, by the rules we learned in school, as six hundred and twenty-five ten thousandths. Now, whether this is everyone else's method or not, it is mine; I simply read it, as you might say, as a compound decimal, as tho it were pointed off like this, .062.5, which reads sixty-two thousandths and five-tenths. I do not remember anyone ever telling me how to read them this way, but have found it a very convenient way.

In the case of a drawing to be used without "mikes" I should give the dimension in question as $\frac{1}{16}\frac{3}{8} + \frac{1}{2}$ of $\frac{1}{64}$ inch. Of course this would look rather awkward, but as I make drawings to work by, and not for exhibition, that would not trouble me much. Taking into consideration that in the drafting-room we have paper, pencils, etc., handy, I think it the proper place to figure out awkward sizes like the above and put them on the drawing in such form that they can be easily read and understood by the man using them. L. A. M.'s rule for halving numbers I think is very convenient. D. W. ROGERS.

A Grinding Attachment.

This attachment can be put on and taken off a lathe in a few moments and does away with an overhead drum with belt and hangers; it is intended for short work and internal grinding only. The shaft B has a spline, so that the drum *A*, which is provided with set-screws to fasten it, can be slid to any position over the lathe bed.



A GRINDING ATTACMENT.

The shaft boxes *C* are self-adjusting and can be raised to take up the slack of the belt *F*, and then secured by the collars *D*. The upper portion of the stanchion *E* is hinged so that the shaft and drum may be swung to conform to the different angles in which the grinder is used, and thereby causing a flat belt to run better on the driving pulley of the grinder. I use silk ribbon for high-speed belts. Any simple form of grinder can be fastened to the tool block of the lathe and belted to the drum *A*. The stanchions are fitted to the slides of the lathe and held by a bolt that screws into a flat piece placed under the inside projections of the lathe bed.

The belt *F* must be connected so it can be readily put together or taken apart. I have successfully used Bristol's steel belt hook fastened to one end of the belt, and holes punched in the other end, so that the hooks when slightly bent will enter and stay as well as when clinched.

A. J. DE LILLE.

The Heat Treatment of Steel.

At page 92 I. W. Antano speaks of the advice of the steel companies, to always take a good cut off a piece of ordinary tool steel. Now, it is not the steel companies' "own process of *annealing*" that spoils the outside of the steel. It comes from the forging and rolling of the bars in the mill. Even with careful handling, when the steel is forged or rolled this soft skin will be there, and it will be thinner or thicker, according to the number of heatings and the time of exposure to the fire in the mill. In tool-making this skin or coat of decarbonized steel should always be removed if a satisfactory job of hardening is to be expected. A chip, say, ⅛ to 3-16, should be removed, according to the size of the bar.

Many an expensive tool is rendered perfectly worthless by not having this skin all removed, owing usually to mistaken economy. The steel is costly, and the toolmaker does not wish to cut it up into worthless chips. The result is an expensive tap, reamer, milling cutter, or some tool of that sort, with soft edges that will not harden; and until the steel user learns better he condemns the steel. These same troubles may be experienced with high-speed steels. Carbon appears to be one of the chief factors of the hardening capacity of high-speed steels, the same as with the old high-carbon steels.

The carbon percentage varies, say, from 0.4 per cent. to 2.2 per cent. with different makes of steel. Some manufacturers claim that the greatest efficiency is obtained where the carbon ranges from 0.4 per cent. to 0.9 per cent., and that higher percentages cause difficulty in forging and that the tools are inferior. With increased carbon content the steel grows very brittle.

If Mr. Antano had packed his milling

cutter in a pot with clear charcoal in the second anneal he would have experienced no trouble. In the first annealing, had he used lime and charcoal equal parts, and sealed it tight to keep all air out, the results would have been better.

For forging, annealing and hardening, the muffle gas furnace is the best tool found on the market at present. The gas gives perfect control of the heat, and the muffle protects the steel from the action of the fierce blast. For hardening, the day may not be far off when the gas furnace will be given a back seat, for a far superior heating tool, the electric furnace.

E. W. NORTON.

Taps for Steel Nuts.

The wearing qualities and the prices of low grades of steel make it a very desirable material for use in the manufacture of nuts, but the difficulties encountered in the working of the stock prevent its universal use. The material is soft and not particularly destructive to the cutting edge of the tap, but, on account of its tenacity is much more difficult to work than iron. If nuts are tapped under the same conditions as when made of iron, very poor results will be obtained, as the tough stock

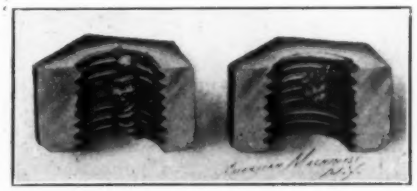


FIG. 1. WHERE A TAP TORE THE THREAD.

allows the tap to carry away large sections of the threads which form an obstruction in the flute and cause the tap to break.

Fig. 1 (sample nut sent) shows a ¾-inch U. S. standard nut which was sawed off a broken tap. It is a good illustration of the manner in which this material acts. Note how the stock has been torn and forced ahead by the cutting edge of the tap; yet so tenacious is the stock that the obstruction shown cannot be removed without the use of a chisel or file.

On examination of a quantity of broken taps of all sizes from ½ to 1¼ inches they were all found to have been broken in the same manner. To remedy this difficulty it is necessary to change the milling of the flutes. Fig. 2 shows a 1-inch tap milled in the proper manner. From the radial line *A*, on which is the cutting edge at the largest diameter, the cutting face must form an arc moving backward at the point of the tooth about 1-32 inch to every 1-16 inch measured along the radial line. This gives a shearing cut and causes the chips to curl somewhat as under the action of a turning tool in a lathe. On large work this chip will sometimes attain a length of several inches.

All taps under 2 inches in diameter should have four flutes. It is advisable to use a tapping machine which will allow the nuts to pass over the tap and be removed from the shank. On the "in and out" tapper the long chips are likely to wedge in the back of the flute when the machine reverses and either destroy the thread or break the tap.

Size of Tap.	Length of Thread.	Length of Taper.	Length of Taper in Angle.	Width of Land.	Revolutions per Minute.
¼"	1¾"	1¼"	⅞"	1/16"	300
5/16	2	1½	1	5/64	300
⅜	2¼	1⅝	1⅛	7/64	250
7/16	2½	1⅞	1⅛	9/64	230
½	2¾	2	1½	5/32	210
9/16	3	2¼	1⅝	11/64	170
⅝	3½	2½	1¾	3/16	130
¾	3¾	2¾	2	13/64	110
⅞	4	3	2⅛	7/32	75
1	4¼	3¼	2¼	¼	55
1⅛	4½	3¼	2¼	9/32	38
1¼	4½	3¼	2¼	5/16	38
1⅜	5	3¾	2¼	11/32	32
1½	5	3¾	2¼	3/8	32

TABLE OF PARTICULARS OF TAPS FOR STEEL NUTS.

Altho the milling of the tap is perhaps the most essential particular, there are various other points which must be given careful attention. In making the regular style of nut tap it is customary to taper and relieve the thread in the angle, commencing deep at the point and coming to the full size at a point where the full thread commences. This taper varies with different makers, but averages from about 1-32 inch on a ⅜-inch tap to 1-16 inch on a 1¼-inch, the object being to cause the tap to take hold of the nut without reaming the hole, and to rough out the thread so that the finished sides will not have to pass over an unnecessary length of tap thereby decreasing the chance of destroying the angle, as in the case of the straight cut tap, which has such a small amount of thread at the point that it allows the nut to rock in the holder, causing the shape of the thread, which is full size at the start, to be changed.

The tap which gives the best results is tapered in the angle 1-16 inch per foot (.005 per inch) on sizes from ¼ to ½ inch and 3-32 inch per foot (.008 per inch) from ½ to 1½ inches, and relieved only on the top of the thread. Referring to the table, it will be seen that the taper does not extend to the full thread. There being no relief in the angle the back of the "land" is larger than the front; at first thought it will appear as tho this would make a hard cutting tap, but on taking into consideration that the taper is very slight, the land narrow, and that the taper does not extend to the full thread, it will be seen that the object of holding the nut firmly on the tap is accomplished without undue strain on either tap or thread, the cutting being done by the top of the land. A tap having much taper and relieved in the angle has a large amount of cutting surface and therefore is a hard cutting tap, besides putting a strain on the sides of the thread which must be avoided in the tapping of steel.

A test of cutting qualities can be made by threading a nut by hand with a tap of each style, using a short wrench to drive the nut, while the tap is held in a vise. For example, try a ¾- or ⅞-inch tap, using about a 10-inch wrench.

In the table will be found proportions and speeds of taps to be used on steel nuts of the regular standard thickness. In nuts of a much greater thickness the tap must run at a slower speed. The table will be found a good basis to work from, the width of the land is measured on the full thread; with the style of cutter advocated it will be somewhat narrower at the point. On all sizes smaller than ¾ inch the regular style of convex milling cutter will give good results provided a selection is made which will be of the proper width to give the tooth a sheared cutting face and yet not cause the back to overhang in a manner which would cause the points of the threads to chip off.

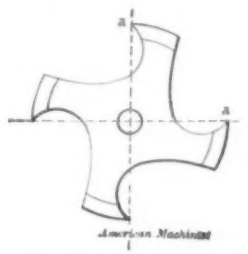


FIG. 2. SHOWING RAKE OF TEETH.

All sizes under ¼ inch will give satisfactory results if cut with a straight thread and unless a very fine fit is desired the ¼ and 5-16 inch sizes also will do very well without being tapered.

ALLAN WINTER.

Educational Value of Advertisements.

From the view point of an advertiser it appears at times as tho there was a large amount of valuable information in reach of many men to whom it would be of great service, providing they would give about thirty minutes of their time every week to properly grasp it, and this information is in the advertising columns of the reliable and high grade, up-to-date trade papers. Look over the advertising columns of this paper to-day; no matter how busy you are you can spare a few minutes to run your eye up and down the pages and I venture to say you will not go far before you will see something that will interest you. If you haven't the time or think you haven't, at the shop or office, take the paper home with you—at any rate, make it your business to at least look it over once a week; it will pay you to do it. If the returns are not immediate they will come eventually. You cannot afford

to go along day by day with the notion that you are making out fairly well with what you have and that you are as well posted in your business as any of your competitors. The new tools and appliances which are brought out constantly have merit which you should be posted upon, or you will, some day, find you are not keeping up near the band wagon. It is much easier to walk close to the music than it is toward the rear of the procession. To bring the matter close home: what is the the most interesting part of our daily papers to the women folks? It is the advertisements, and this is where they show their good sense. They keep posted, know when a new household article is brought out and investigate it. I know it to be a fact in my own household it formerly required thirty minutes to make bread by hand; now they make it in five minutes (with a three-dollar machine), make the same quantity as before with less flour, and this saving of time and material was accomplished thru reading advertisements.

This same thing is happening among machine shops, but the live, level-headed manager encourages his men to find out about the new tools, and he wants to learn what improvements are being made on the old ones; if he doesn't it will be only a matter of a short time before he needs more dough to do the same amount of business than some of his competitors require, and this means that his barrel will be empty before theirs.

There are many men to-day who have responsible positions, who are honest and reliable, and apparently getting good results, but who could get better results if they only knew of a certain machine which will do about double the amount of work as the style they are using; the machine is on the market, but they don't know about it; why? because they are too busy to read the trade paper advertisements.

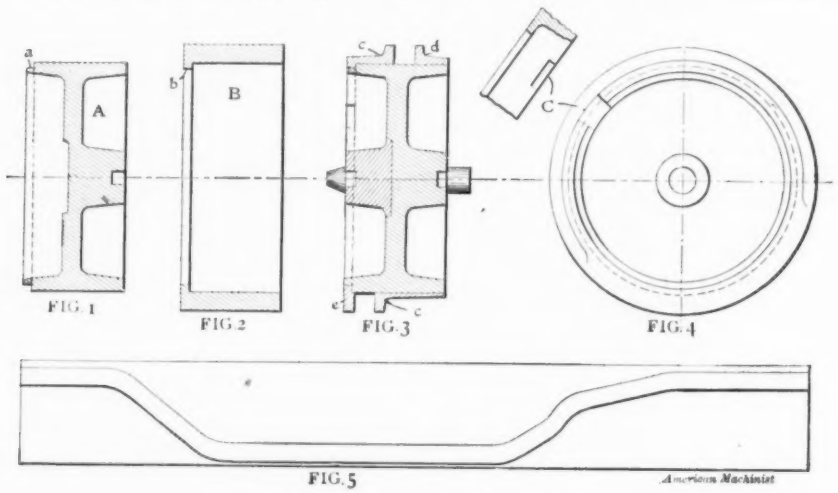
Read the advertisements, it is worth your while. This is especially so of the advertisements in the columns of this journal.

MORRIS G. CONDON.

Philadelphia.

Making Drum Cam Patterns.

I have made a number of drum cam patterns as shown by the sketches. I first turned up the inside body of the cam *A*, as shown in Fig. 1, turning a recess *a* into the rim on the cope side. The outside diameter of this piece was the same as that of the bottom of the cam track. I then turned a rim *B*, Fig. 2, having the same width of face as *A*, with a lip *b* on the inside to match the recess *a*. The outside diameter of *B* was the same as the outside diameter of the cam. The inside diameter of *B* I made about two thicknesses of ordinary drawing paper larger than the outside diameter of *A*. This was to give clearance to the loose piece *e*, Fig. 3, so that it would slide freely off of *A* after it was varnished. I then took a piece of tracing cloth and cut it the width of *B* and in length equal to the circumference of *B*. On this I laid off the development of the cam track, as shown at Fig. 5. On *B* before taking it off the lathe I scribed parallel lines corresponding to the sides of the cam track at the "dwells." This saved some time in laying off the lines on *B*. I put the tracing around *B* and fastened it with several thumb tacks, then with a sharp knife following the lines describing the track I cut them into the wood, which operation also removed the tracing, and the cam was then ready to cut out. This was done by boring several holes thru the track, sawing out with a compass saw and then paring the edges true. The surplus stock outside the cam track was pared out also, as shown at *c*, Fig. 3. The side of of the cam track was then fastened to the drag side of *A*. A piece of drawing paper was first put around *A* and then the ring was slipped over it, so as to make a close fit. As before stated, *d* had been turned just so much larger than *A*. The paper was then trimmed off with a knife by following the side of the track. The other side *e* of the track was then put on and located properly, and a small lug was fastened to it, as shown at *C*, Fig. 4, which held it from shifting.



MAKING A DRUM CORE PATTERN.

The patterns were molded in a three-part flask and the castings were all that could be desired.

E. S. MUMMERT.

Hanover, Pa.

Proving Multiplication.

At page 1373, Vol. 27, H. I. gives his method of proving a multiplication problem, and on page 87, Vol. 28, Edward Serra offers what he considers an easier method of doing the same.

These two methods are really the same for, by each, 9 and all its multiples are eliminated from the multiplier, multiplicand and product, the only difference between them being in the way in which the nines are eliminated.

The method which I use is the same as theirs in its results, but I think my way of eliminating the nines is much simpler and easier to understand, and involves less mental work.

To prove the correctness of a multiplication I divide the product by 9 and set down the remainder, if any, no attention being paid to the quotient, as only the remainders are used.

The multiplier and multiplicand are each divided by 9 and the two remainders are multiplied together and the product thus obtained is divided by 9 to obtain the final remainder. If the work is correct, this final remainder must be the same as that obtained from dividing the original product.

That comparison may be more readily made, I use as an illustration the example given by H. I.:

```
134.95 ÷ 9 = 4 remainder.
3.1416 ÷ 9 = 6   "
-------------   ---
 80970          24
 13495
 53980
 13495
 40485     24 ÷ 9 = 6 remainder.
-------------
423 958920 ÷ 9 = 6   "
```

As will be noticed, no attention is paid to the decimal points in proving the work.

As another example, take:

```
369 ÷ 9 = 0 remainder.
167 ÷ 9 = 5   "
-------   ---
 2583     0
 2214
  369
-------
61623 ÷ 9 = 0 remainder.
```

With correct work in proving, the only error that would not be detected by this method would be where the product was too large, or small, by 9 or some multiple of 9.

That these three ways of eliminating the nines should produce the same results is because of the somewhat curious fact that if any number is exactly divisible by 9, the sum of digits will be 9 or a multiple of 9, and the remainder left after dividing any number by 9 is the same as the sum of its digits will exceed 9 or some multiple of 9.

In connection with this I will give some other curious facts in regard to the number 9, showing its importance in math-

ematical work, and which may be new to some readers:

Besides the naught, which has no value of itself, there are nine digits, and the sum of these digits is 45, a multiple of 9, and the 4 and 5 added together again make 9. If 9 be multiplied by any number and the digits in the product added together, their sum will be the inevitable 9 or its multiple. F. C. HENDRICK.

At page 87 Edward Serra gives a method of proving multiplication that is all right as far as he goes with it. Let's look into it a little farther and see how much simpler it can be made.

Consider first the figure 9. Any number less than 10 when multiplied by 9 will have for the sum of the figures in the product 9.

$$9 \times 1 = 9$$
$$9 \times 2 = 18 = 8 + 1 = 9$$
$$9 \times 3 = 27 = 7 + 2 = 9$$
etc., etc., etc.

Now let's look at the example given:

$$134.95 \times 3.1416 = 423.58920.$$

Adding 1, 3, 4, 9 and 5 the sum is 22, adding the 2 and 2 of the sum we get 4. Continuing the process and adding 3, 1, 4, 1 and 6 we get 15, and adding the 1 and 5 we get 6. Now multiplying the 4 and 6 we get 24, which added gives 6; thus doing away with the mental effort of determining how many 9's there are in the 22, the 15 and the 24—in other words, the 9 does its own casting out. The rule for the operation is then: Add the integers in the multiplier and if the sum is more than 9 repeat it until it is less than 9. Do the same with the multiplicand, then multiply the results obtained and add the product as before, doing the same to the product of the numbers originally multiplied, and if the results obtained are the same the numbers are multiplied correctly, as a general thing. The chance for error arises by the transposition of figures. For instance, the sum of 234567 will be the same as 324567.

Referring back again to the property of the figure 9 to always have 9 for the sum of its product, any time the sum of the figures in the multiplier or the multiplicand adds 9 the sum of the figures in the product must be 9.

This proof can be applied to addition as well as to multiplication, as one is a kindred process of the other. Three times a number is the same as the number added three times. As, for example:

23456789 = 44	8	
98765432 = 44	8	added
43256748 = 39 = 12 = 3		= 19 = 1
165478969 = 55 = 10		= 1

In this the error of transposition can occur as in multiplication. A little care will overcome this, so that the chance is very much reduced.

A little observation will show many "freaks" of figures that will help in many operations; for instance, 5 is a half of 10, so to multiply by 5 divide by 2 and add a decimal place, and conversely to divide by 5 multiply by 2 and take a decimal place. Likewise 25 is one-fourth of 100.

I note how L. A. M. halves fractions at page 61. I have used this way for a number of years and have yet to find a quicker, easier or more sure way. G. F. M.

Decimal Shop Time Measurement.

The plan devised by Wilfred Lewis and described at page 1729, Vol. 27, under the heading "A Decimal Time-Measuring Clock," has impressed me as a decided convenience.

Still, the necessity for changing the works of the clock by altering the gear train ratio of hour and minute hand from twelve to ten, and still more the necessity of stopping the clock during the noonday-rest hour are decided inconveniences; the latter becomes accentuated as the number of clocks is increased. Undoubtedly clocks could be readily devised that would automatically rest during the noon period; they would, however, be costly unless there were created a considerable demand for them.

THE CLOCK.

Both these inconveniences can be quite readily gotten over. The standard dial is supplemented by an additional set of figures as illustrated; these are decimal divisions of the entire clock face and for reading in connection with the minute hand only. For greater convenience these may be marked in red and the minute hand also painted red. Say that a job is started at 7 A. M. and finished by 9.30 A. M., it has occupied 2½ hours. By the clock the reading would be:

Start with hour hand at 7,
minute hand at 0 . . . . = 7.0
Finish with hour hand past 9,
minute hand at 5 . . . . = 9.5

Elapsed time . . . . = 2.5 hours

Similarly for a job started at 1.30 P. M. and finished at 5 P. M., the time taken is 3½ hours. By clock reading:

Start with hour hand past 1,
minute hand at 5 . . . . = 1.5
Finish with hour hand at 5,
minute hand at 0 . . . . = 5.0

Elapsed time . . . . = 3.5 hours

For jobs that are not finished during the morning period but are finished in the afternoon, it is only needful to increase the P. M. time reading by 12 and subtract the A. M. reading from this total; this holds true also for work extending from the afternoon of one day to the morning of the next. For instance, a job started at 7 A. M. is finished at 5.30 P. M. of the same day occupying 9½ hours. By the clock the reading would be:

Start with hour hand at 7,
minute hand at 0 . . . . = 7.0 A. M.
Finish with hour hand past 5,
minute hand at 5 . . . . = 5.5 P. M.

Add 11 to the P. M. reading,
gives 16.5, and this less 7
gives: Elapsed time . . = 9.5 hours

The reason for adding 11 instead of 12, as might at first blush be considered proper, is the falling out of the noontime.

If 0.1 hour is the smallest time amount to be considered, it will be convenient to halve each tenth hour division in the outer or long hand circle; with the hand not arrived at this dividing mark the reading of the figure just passed is taken; when the hand has reached or passed the mark the next figure ahead is noted.

As outlined so far the conditions of the working day with a noontime intermission are taken care of. Many shops give a noon recess of one-half hour only; adding 11.5 instead of 11 takes care of this.

Similarly, overtime after 6 to 12 is taken care of if there is an hour intermission at noon and another from 6 to 7, by adding 10 to the P. M. reading and subtract the A. M. reading from the total. If there is no A. M. reading and consequently no noontime intermission, 11 is added. This change in the adding figure is explained more to show the general applicability of the method to all conditions than because it is likely to arise. Overtime work is usually paid for at a different time rate so that clock readings will usually be taken and considered separately for the regular and overtime periods; in that case, naturally, the adding figure remains the same.

HENRY HESS.

A Tribute to William Sellers.

The death of William Sellers has removed the peer of all machine-tool builders of the present age. A man any employee could approach no matter how humble his position might be, he always had time to hear what he had to say; a mechanic both in the shop and at the drawing board. A few years ago, when the United States Government asked the tool builders for prices and plans on gun lathes, William Sellers & Co. were bidders. All the tool builders that bid had representatives at Washington. William Sellers represented his company in person, and was the first speaker. It was a hot day and Mr. Sellers laid off his coat and explained

his plans to the Board of Engineers in detail from the first screw in the headstock to the last bolt in the tailstock. When he sat down a very prominent officer of a large tool works turned to his engineer and said, "George, now it is your turn." George shook his head and said, "Mr. Sellers has said all there is to say." He could not add a word.

I have known Mr. Sellers many years and worked for him several years in various capacities. I have met a great many men in my mechanical career, but never met but one William Sellers. He leaves a vacancy hard to fill.

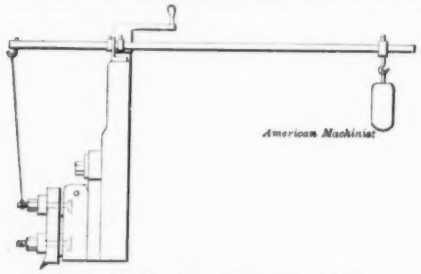
Jos. H. SPRINGER, SR.

Louisville, Ky.

A Balance for a Clapper Block.

The weight of the clapper block dragging on a planer tool is known to help a great deal to dull the edge, and when dragged over an uneven surface where there are lugs and open places it not only sometimes cracks small pieces off a self-hardening steel tool, sending it more often to the grindstone, but it has a tendency to jar the tool or head downward, taking off more than wanted.

There are many times that a man needs



A BALANCE FOR A CLAPPER BLOCK.

to lift the tool up high, as is the case when using an L tool. To lift tool on even a small planer any great length of time soon becomes irksome. To lift the tool of a planer 8 or 10 feet wide is next to impossible. The sketch shows a method I think a good one for taking the weight off the tools when dragging back. I have used it with great success on a 120"x120" 36' planer doing a good deal of L-tool work.

A little L-shaped bracket is fastened on top of the slide, a piece of 1-inch pipe is passed thru a hole in it, and a set collar placed on either side. A small chain or wire is then attached to one of the bolts of the tool block and the other end to a hook on the pipe as shown. On the back end of the pipe is another collar with a hook. A suitable weight is hung on this and the collar is then moved back and forth to balance the weight of different tools used. The arrangement is very handy where a drag is used to lift the tool out of a slot, as it allows the tool to drop off the back end with little jar.

Any fellow wishing to try this can quickly rig it up with a wooden pole and use large nails in place of the set collars and wire instead of a chain.

H. L. CAMERON.

A New Way of "Laying Off" Templets.

An article at page 1743, Vol. 27, headed as above, describes a method devised by Mr. Alteneder for production of exact working lines upon steel.

This method with slight modification, was employed by me about two years ago. I may preface with the statement that I am an amateur machinist, and proceeded with the method, considering it a matter of course and not with any idea that I was engaged in anything new.

I had occasion to make a number of co-operative cams for a model on a 1-5 scale. The cams were cut from 3-16 inch steel, and were in pairs. I laid them out upon the metal with my greatest exactness, but found it impossible to scribe them upon the steel with sufficient accuracy to give me a satisfactory working line and found it equally difficult to work to the line I had found. The final result was unsatisfactory, as the cams when in place required so much fitting that they eventually proved a misfit. I concluded that in practise there must be a method insuring better results and that it must be arrived at thru a mechanical reduction of drawings made on a larger scale.

I mounted some Whatman paper upon a sheet zink, thus insuring a surface not subject to changes by humidity, but as my zink proved too small to contain my points of development I concluded to use bristol board. Upon this I laid off the cams full size (five times the size to be used).

The steel I had prepared by a plate printer, with a surface for engraving. My drawing I took to a firm of photographers noted for their exactness in enlarging and reducing maps and work requiring the preservation of a scale. They furnished me with negatives upon which, by ordinary measurement assisted with a fair magnifying glass, I could not discover any variation from the measurements called for. I may here say that the outlines of the cams had been filled in with solid black and that the centers of the holes for mounting cams had been indicated. The negatives and the steel plates were taken to a photo-engraver who returned the steel with the cams rolled up in ink and etched in slight relief. After the relief had been increased to a satisfactory degree the plates were cleaned and the cams appeared as highly polished surfaces in relief upon a matted ground, with centers marked and otherwise ready to go to the vise.

There was no difficulty in adhering to the line and the cams in place proved to be nearly perfect, requiring very little correction and even this for the greater part the result of caution. In this case the work between the drawing and the vise had been performed by specalists and this probably accounts for the success of what had been my first effort and possibly the first effort in the employment of photography for the purpose of obtaining working lines upon steel.

The excellence of the modern lens insures results commensurate with the care taken in preparing the negative and exposure, the size is limited by the field. If there are objectionable features in the method I have not discovered them. Of its many applications there can be no doubt, and its advantages to the die maker in securing any number of perfect outlines from one negative are obvious, and I am surprised that there is anything new about it.

F. H. LINDNER.

I would respectfully request A. Mateur —who lays me out at page 117—to carefully and compassionately reread my letter at page 1743, Vol. 27. I would further beg that he be as easy as possible with me, for I am not in his—the "A. Mateur" class. I did not state that the reduction was from a drawing either ten times or a hundred times as large; as A. Mateur seems to think. What I did write was, "say ten times actual size," "say a hundred times as large," etc. The word "say" in this connection means "for instance," "assume," "for example." Further, I did not mention anything about measuring on the ground glass, altho the first rough measurements were upon the ground glass.

The camera was made of two poplar boxes, one sliding within the other, the inside surfaces blackened. The lens was not a rectilinear, but a Goertz anastigmatic. A small tin templet the total length of the finished templet was made and mounted on a little wire handle. The drawing—*ten* times the actual size of the finished templet—was mounted on a board. The camera was placed on a track at right angles to this board, and moved along until the image on the ground glass was approximately the same size as the tin templet. Three negatives were taken and finished at this setting. After the negatives were dry, they were placed under the microscope of a dividing engine. The screw was set at zero. The negative was then slid along until the line at one end of the image of the templet was directly under the cross hair of the microscope. The table with the negative on it was then moved the length the templet was required to be. Any variation was readily detected and measured with the dividing engine. The camera was moved along the track either toward or from the drawing, three negatives being taken at each setting and these measured as before until the correct position for the camera was found. After that the camera could be relied upon to reduce to one-tenth as long as its position and that of the object were unchanged. The variation of the three final negatives was very much less than .001 inch. After the correct negative was obtained, the steel templet was printed from it. The templet was then given to the best filer in the shop. With the aid of a powerful glass the templet was filed very close to the line. It was then compared with the negative. I have in my possession one of the negatives that was either under or over size. The glass

is about 3½x2½ inches, the image about 1⅞ inches long by ⅞ inch wide. The outline is a clean parallel line about .004 inch wide on a nearly black surface.

Before filing the outline of the templet the edge opposite the formed edge was straightened up and one end made square with it. A guide was fitted and clamped to the negative for the straight edge of the templet to slide upon. A stop was also fixed to the negative to bear against the squared end of the templet. The film of the negative is very thin. Owing to the inequalities of the glass it cannot be measured with an ordinary micrometer, but it must be considerably less than .001 inch.

With these stops on the negative it is an easy matter to compare the templet with the negative. By moving the templet toward the dark outline of the image the defects are easily seen. A touch with a file or stone makes the corrections. With an edge less than .001—the thickness of the film—an error of .001 will be very readily detected. It is a well-known fact that errors of this magnitude are easily detected with a knife-edged square.

If A. Mateur will turn to page 260, Vol. 24, he will see this statement corroborated by A. B. Christman, who seems to know what he is talking about. The final perfecting of the templet is merely a question of patience and skill.

In my first letter I gave a general outline of Mr. Alteneder's method. Anyone who has two of Alteneder's instruments of the same size and style, and a good micrometer can find out more of the perfection of these tools in five minutes by comparing one with the other than I could write of in five hours. If the information had been given me by a dilettante it would never have seen the light of day in the AMERICAN MACHINIST until I had had a chance to verify it.

Will someone who thoroughly understands lenses and their extreme accuracy tell us how they are tested and what limit of accuracy or inaccuracy is allowed? There must be a difference between the lens costing a dollar or so and one costing a hundred dollars or more. There must be some expenditure of skill to so enhance the price of glass. DIXIE.

The publication of the facts regarding the finding of water in the yard of an engineering establishment in England, as published by us some time ago, and afterward commented upon by ourselves and some of our contemporaries, seems to have aroused discussion of the subject, in England particularly, which discussion is still going on. *The Times* has taken it up and has published many communications on the subject, it having recently summed up the whole matter by suggesting practically what we suggested should be done by one of our contemporaries here—that is, not to theorize or to assume that facts stated by reliable people were not true or were misinterpreted, but to make a careful investigation. This is the only way in which it is likely to be proven whether there is anything in this matter or not, and if so, what it may be that is in it.

Accurate Screw Cutting.

Practical mechanicians would not be apt to use all of the expressions made use of in a report from United States Consul Hamm, of Hull, England, on the subject of a "Standard Screw," but the report is nevertheless interesting, and is as follows:

"The need of a standard screw in the more delicate branches of engineering has long been acknowledged by the profession. This lack has been especially evident in optics and gunnery; but the difficulties in the way of obtaining such a standard have been just as evident. The British war office seems to have overcome most, if not all, these difficulties, and to have succeeded in constructing one which it is claimed will stand every test.

"Recognizing the importance of having a standard screw in gun fittings and mountings, the war office was led, four years ago, to appoint a committee of experts to investigate the subject and devise means for the production of the article wanted. The result of the labors of this committee can now be seen in the new standard screw-cutting lathe just set up at the National Physical Laboratory at Bushy House, London.

"It became clear at an early stage of the investigation that to secure interchangeability in screws it was necessary to supply accurate standard leading screws from which the screws could be cut and to construct a special lathe on which these leading screws could be adjusted and measured. The standard screw now in Bushy House is made of compressed steel and is some 6 feet in length. The lathe to which it is attached exceeds 20 feet in length, and as it works to so fine a degree of accuracy as to correct an error of one ten-thousandth part of an inch, every precaution has been taken to protect it from the vagaries of temperature by housing it in a special building heated to a constant temperature of 60 degrees. The lathe differs in construction very greatly from ordinary lathes. The leading screw and the screw to be cut are coaxial. No gear wheels are employed, and there are means for automatically correcting even the most trifling errors of the leading screw.

"The lathe room, which is air-tight except for the ventilation afforded by inlets and outlets, is completely surrounded by an outer shell, and is provided with a glazed roof, while a glazed partition at one side enables observations to be made from the outside of the room. To prevent vibration, the lathe has been fixed on a foundation consisting of 20 tons of concrete covered with 6 inches of cork stone. The power is supplied by a 5 horse-power motor, and arrangements are made for driving the lathe mandrel direct from the outside of the room. In this way the presence of anyone within the lathe room can be dispensed with for considerable periods at a time, and the machine with its automatic corrector can, under vigilant but unobtrusive supervision from without, be safely left to perform its allotted task with perfect fidelity and with such marvelous precision as almost to render the copy more perfect than the original.

"For scientific purposes a screw must be so accurately cut and its axis so true that it will move forward in its nut exactly the same distance for each rotation around its axis. If the axis of a screw is straight it will run true at every point. It is said not to be difficult to produce a screw a foot or a yard long with errors not exceeding one-thousandth part of an inch. Prof. William A. Rogers, of Harvard Observatory, invented a process by which a tool lathe while cutting a screw moved so correctly as to counteract the errors of the lathe. Machines have also been invented the errors of which, it is claimed, do not exceed one one-hundred-thousandth part of an inch at any one point. But the results have seldom been satisfactory. To secure the highest accuracy it has been necessary to resort to grinding.

"If the lathe now at Bushy House produces a standard screw which will bear the test, one of the most difficult problems in engineering will have been solved. Every engineer will be relieved of an embarrassment he has had to encounter. A public test has not yet been made at Bushy House, but when that is had engineers in all parts of the world will watch for the result with intense interest."

Our impression is that lead screws or guide screws, as our British cousins call them, had been produced with sufficient accuracy, and that they had been mounted in lathes capable of reproducing their accuracy with an approximation plenty close enough for all practical purposes. The term "coaxial" we suppose means that this master screw and the screw to be cut are in line with each other, or, in other words, that their axes lie in the same straight line, and this construction is unusual, if not entirely new. By it several bothersome factors are eliminated, chief of which, perhaps, is the necessity of producing and maintaining an absolutely straight slide for the moving carriage.

Both a standing and a running balance should be secured and maintained by all millers, all mill owners and mill managers. This advice is not confined to the balancing of the millstones and other revolving machinery in the mill, but to the individuals themselves. They must keep their heads on a poise, well balanced all the time. The miller who does not maintain a self-poise is not well calculated to keep his machinery, his buhrs, his business in good working balance.—*American Miller.*

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The Suggestion Box in England.

Our amiable contemporary, *The Engineer*, of London, announces that among the ideas imported from America, and tried there, is the suggestion box in which employees of engineering works are expected to make suggestions for improvements pertaining to the work. It states that this suggestion box has been a failure in England and gives its reasons, among which are the following: "To invent or devise the improvement of a method involves an action of the imagination. Imagination of the kind may, and does from time to time, spring in brains not specially trained, but as a rule it is the outcome of a system of education. The works manager is not born; he is made. . . . It is therefore only in very simple cases that the workmen's powers are likely to meet a problem which they are capable of solving, and such simple problems are more likely first to present themselves to the manager and his assistants, who are prepared with all the machinery for their solution." Thus it is proven, to the satisfaction of our contemporary at least, that workmen cannot be expected to make suggestions pertaining to their work that are likely to be of any value, and tacitly, if not in words, it advises its readers to give up all attempts to have them do so.

In some shops in this country the suggestion box has proved a very great success. Suggestions have been made by the men that have proven to be of considerable value, and establishments are continuing the use of the suggestion box after having tried it for a number of years and with the best results. There may be, between the English and the American workman, such a difference of constitution or of mental habit as to make this thing work well here and not work at all in England, but we do not believe it. We believe that before it can be definitely determined whether the suggestion box will work well in England or not, it needs to be given a much more extensive trial than we understand has yet been given it there.

While we have not gone into a careful or extended investigation of the matter, we feel pretty certain that workmen whose original training was obtained in Great Britain and who now work here as freely make suggestions, and just as good ones, as do men of any other nationality. Is it American air that makes these men freely do things here which they do not do at home? It seems more likely that it is difference of shop conditions. In some American shops the suggestion boxes have not worked well, in others they have. There are other things that go with the boxes and that are necessary to make them work well. In some shops we believe very much the same results are obtained by other methods. The first suggestion box we ever heard of was adopted because the proprietor of the establishment learned that suggestions made by workmen were in some cases suppressed by jealous and small-minded foremen or superintendents, and in other cases stolen by dishonest ones. Perhaps there is none of this difficulty in England. However that may be, we feel very confident that men in shops here or elsewhere can, and will, make valuable suggestions regarding the work if the conditions are made right for their doing so—not necessarily by a suggestion box, but in some way. A foreman who maintains an open mind, and who, when he receives a suggestion from a workman, behaves himself in such a way as to encourage a repetition of such a thing, and who when the suggested plan is at work shows it to the superintendent or proprietor and lets the workman unmistakably hear himself given credit for it, will need no suggestion box. He will usually receive plenty of suggestions without the box and occasionally one of them will inevitably be a good one. Moreover, if that foreman is otherwise all right, he will have every man loyally devoted to him and doing the fair thing; and that is of no small importance.

Municipal Enterprises in England.

We are constantly seeing articles reviewing the municipal ownership matter in England and making what appears to be a bad showing for it. The managers of these municipal enterprises in England are charged with not keeping their books just right, with not charging enough for depreciation of plant, and with making expenses of operation larger than they ought to be; in short, with not managing street railways on good business principles. Some of our contemporaries endeavor to make much of this, but it seems to us that they will not make much headway against those who advocate public ownership, or at least greater control of such public utilities, by arguments of this kind, because they do not touch the main point, the main point being that in American public life to-day the ownership of monopolies involving public service is notoriously one of the worst and most corrupting influences. The strife for valuable franchise monopolies, the endeavor to get favors of various kinds from municipal and other legislative bodies has been for years, and is now, one of the greatest obstacles to the election of honest and fair men as members of these legislative bodies. For it is obvious that when men who belong to public service corporations are put up as candidates and their election purchased in order to secure legislation favorable to these monopolies, these same men may be readily purchased for any other interest which has the price; or, in other words, that no such thing as honest legislation, in the interest of the people they are supposed to represent, can be expected from a legislature constituted in this way except by accident or, where it happens that no financial interest stands in the way of such legislation.

It is of no use to declaim about the right of private enterprise and so on. No level-headed man contemplates the absorption

by the government of the boot and shoe factories, or the grocery stores, or the newspapers. It is proposed only that those things which are in the nature of public service, such as water works, gas works, street railways and other railways shall be owned or more or less controlled in the interest of the public instead of being controlled in the interest of any private gang of manipulators which may happen to gain possession of them. There is no valid argument against this in simply an array of figures showing that public officials do not always run these enterprises in what may be called the best possible business manner.

We do not have to go very far back to find a time when the country was gridironed with toll roads. Some of these still exist and are privately owned wagon roads, over which the public, in traveling, must pay toll. No doubt figures can be given—in fact, figures have been given—to show that the construction and maintenance of these roads are carried on under better business conditions, or in more businesslike way and at a greater profit under private ownership than by the public; but do we wish to go back to the day of toll roads on that account? We do not. And the reason is that the question of whether a road is managed to make less money for the public than it has been or might be managed to make for a private owner, misses the main point of the argument. No one wishes to go back to toll roads, and for very good reasons, and the few that still remain are being rapidly made public.

If one will consider the essential and vital difference between the business of making motors and other electrical apparatus under competitive conditions and the business of franchise grabbing, legislature buying and general graft; especially if he will carefully consider whether it is better for the telephone business to be competitive, as it is in many places here, or to be closely monopolized, as it is in New York city, he may see a new light in these matters.

Technical and trade journals which lead their readers to suppose that legitimate manufacturers have interests in common with oppressive monopolies are doing what they can to mislead, tho not of course always intentionally. There are of course arguments that may be presented on both sides of the question, but the matter of whether municipally conducted work is profitable or not, considering simply receipts and expenditures, is entirely aside from the main question and consequently can produce little or no deterrent influence.

According to a local newspaper an Indiana genius proposes to utilize cats for the generation of electric current for lighting. His purpose is to round up the cats and drive them thru a chute so that they will pass under rotating brushes which will abstract the desired current.

New Tools and Machine Shop Appliances.

SOME TURRET LATHE IMPROVEMENTS.

The cuts, from a recent United States patent to Walter L. Cheney, of Meriden, Conn. (not a stranger to our readers), show some interesting novelties in lathe design. The ideas embodied are properly applicable to a turret lathe. The usual slide-rest is dispensed with, and one or several tool slides and carriers are made integral with or attached to the front of the headstock. One immediate result of this is that the turret is permitted to come up close to the work, instead of standing off and operating with long, slim, springy drills or other tools, as is often unavoidable. Another result attained is that several tools may operate upon the work at the same time, performing different operations, and these tools may be arranged opposite each other or in symmetrically spaced positions which will enable the cuts to oppose and balance each other and eliminate the side thrusts and strains upon the work and the spindle.

The cuts are crude and unsatisfactory, but they show enough to enable one familiar with the turret lathe to understand the arrangement. Fig. 1 is an alleged perspective view of a turret lathe with the improvements. Figs. 2 and 3 are front and side views of three tool-carriers attached to the headstock, and Fig. 4 is a perspective illustrating the simultaneous operation of three turning tools and the twist drill upon a piece of work rotating in the usual way. Bases 10, 11 and 12 attached to or forming parts of the headstock each carry the usual details of a compound rest, providing for swiveling and for sliding the tool-holder in either rectangular direction. The slides as here shown are all operated by hand, but in later developments automatic movements may be provided for. In Fig. 4 the drill

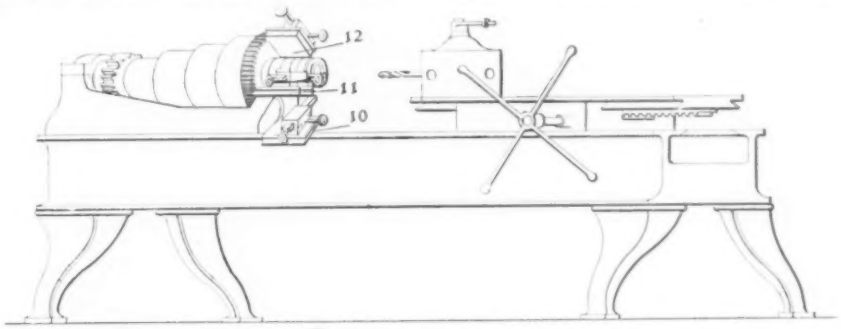


FIG. 1

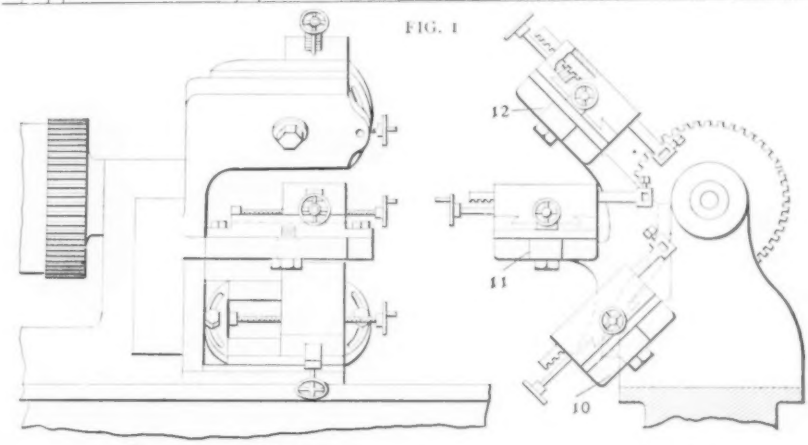


FIG. 2 FIG. 3

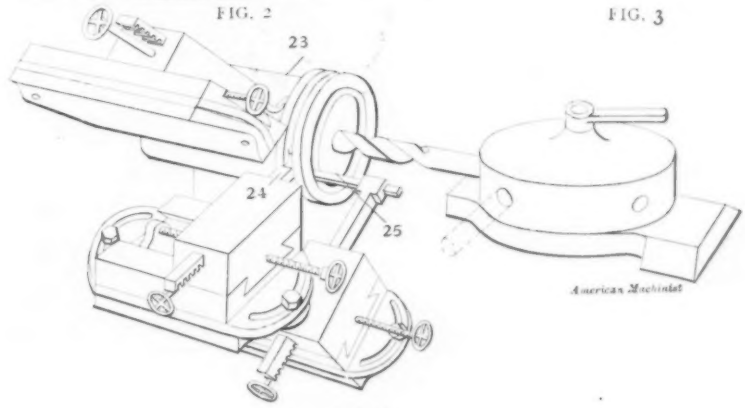


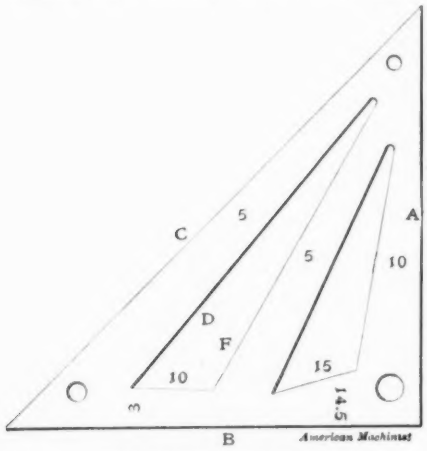
FIG. 4

TURRET LATHE IMPROVEMENTS.

is assumed to be automatically boring a hole in the work, while tool 24 is making a peripheral groove, 23 is turning in the corner and 25 is making a groove in the face.

COMBINATION TRIANGLE.

This triangle is made of transparent celluloid by Max C. Zange, 417 Washington avenue, New Haven, Conn. It combines



COMBINATION TRIANGLE.

the 60° and 45° triangles and several other common angles in one instrument.

The numerals denote the angle between the edges on each side of the numeral. Thus, the angle between edges *C* and *D* is 5, or when referred to edge *B* the line *D* makes 45° + 5° = 50°, and 45 — 5 = 40° with edge *A*, both lines being perpendiculars to each other. Edge *F* is the one which makes 60° with *B* and 30° with *A*, but 15° with *C*. The combination of the angles allows 26 radii to be drawn in one quadrant, also a number of regular polygons as triangle, square, hexagon, octagon, nonagon, etc. The ruling edges are long and start close to the T-square, a decided advantage in combination triangle construction. The round holes near the vertices of the triangle are useful in section lining as follows: Draw a line with the 45° edge, then place the pencil point thru the hole and against the side away from the 45° edge and move the triangle along the T-square until the opposite side of the hole strikes the pencil point, then draw another section line and proceed as before.

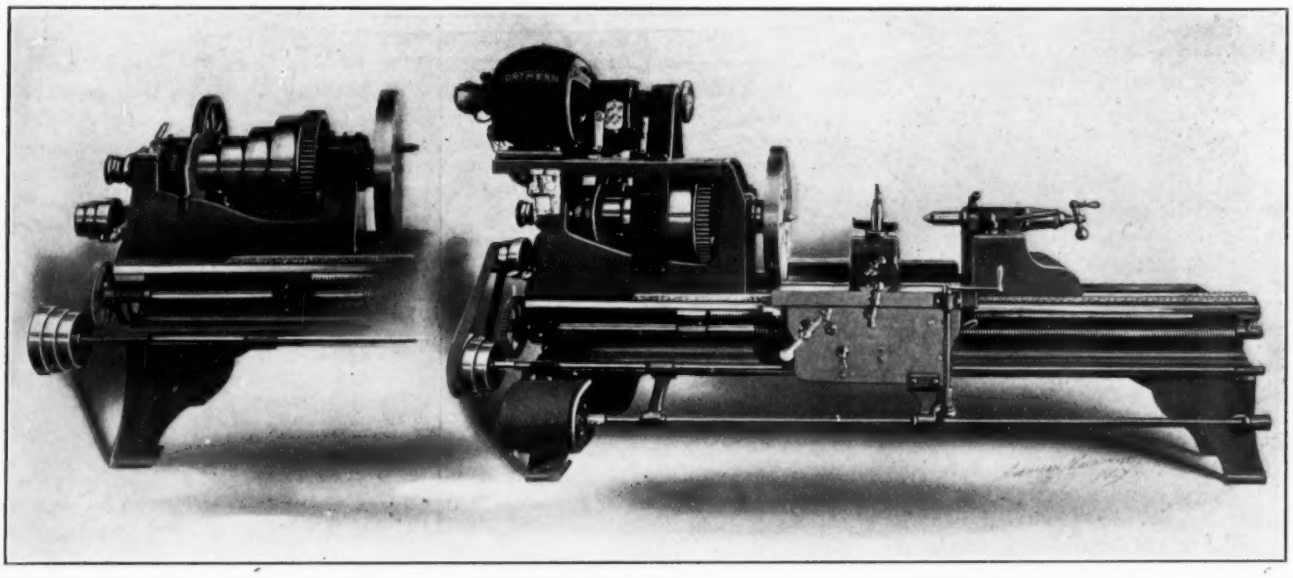
Projecting from the face of the instrument is a pin which enables the triangle to be easily raised from the drawing without touching the edges. This pin always projects from the triangle no matter which side is against the board, a decided convenience, as it avoids the sliding of the instrument over the drawing.

A REMODELED LATHE WITH MULTI-SPEED MOTOR.

The term multi-speed is applied by the Northern Electrical Manufacturing Company, of Madison, Wis., to a variable-speed motor having in addition to the electrical speed changes mechanical changes incorporated with the motor and the accompanying illustration shows their multi-speed motor applied to an existing lathe, the left-hand view showing the lathe in its original form. The multi-speed feature is a gear box with a lever for operating the gear clutches, the arrangement being such that, with the lever in one position, the motor speeds are carried directly thru the driving shaft, while with the lever in the opposite position reduced speeds are transmitted. With the lever in the intermediate position the lathe stops, altho the motor runs on.

In the case of the lathe illustrated, the old stepped pulleys had a ratio of 7 to 1. In the combination which replaces the belt drive, the variation in motor speed is 2½ to 1 and the gear ratio 2.83 to 1, thus giving approximately the ratio previously secured with the stepped pulleys. The method of attaching the device to the lathe illustrated is simple. The spindle bearing caps are removed and in their places is substituted the platform upon which the motor is placed. Provision is made for taking up the wear of the spindle bearings by providing a suitable adjusting screw and lock-nut. The connection between the motor and stepped pulley is by a silent chain, a split sprocket wheel being bolted to one step of the pulley. This method of drive can be adopted, or, in the case of a new lathe, a separate sleeve can be made to carry the sprocket wheel in place of the stepped pulley. The clutches are termed friction-positive clutches, and consist of an arrangement whereby the motion of the hand lever first throws in the friction element of the clutch until the speed is brought up, when a further movement of the lever actuates other members so that the driving becomes positive in character.

While the variation of the combination illustrated is about 7 to 1, it will be readily understood that quite a large variety of speed ratios can be obtained by this arrangement. The lathe as previously arranged for belt driving had only eight speeds. With the new arrangement, by using a 20-point controller, eighty speeds are possible. While it is true that a few of the higher speeds are not of any particular value, it is also true that a high number of speeds does facilitate lathe operation, particularly with reference to facing work, as thereby more uniform cutting speed can be obtained than with the old belt arrangement. All electrical speed changes, both with and without the back gear, are obtained by means of the handle shown at the right of the carriage, which operates the controller by means of a short vertical and a horizontal shaft, as shown. With the exception of the back gear change, the operator need not leave his position at the carriage to obtain any speed within the whole range of the machine. The motor shown operates on the two-wire system.



A REMODELED LATHE.

AN AUTOMATIC PRESS FOR PHOTOGRAPHIC BUTTONS.

The half-tone, Fig. 1, shows another of the special automatic forming presses made by the E. W. Bliss Company, Brooklyn. This is employed in the manufacture of the buttons used in certain automatic nickel-in-the-slot photographing machines. As the sensitized photograph plate is used the press is operated in a dark room with ruby or orange light. The buttons have heretofore been made in foot presses requiring a separate machine and operator for each operation, and the capacity of a set of presses was not equal to one-half that of the present machine.

The press has a dial feed which carries the work successively under the three punches carried by the main slide. This dial feed is operated by an eccentric on the main shaft at *D*, thru the rod to the bell crank *E*, which operates the slide *F*, this slide carrying a pawl which rotates the dial. In addition to the three punches carried by the slide there is a sub-press operated by the arm *N* projecting from the front of the slide. The stroke of the sub-press is adjusted by the screw *O*, and the sub-press is raised by the spring *P*. The button backs *V*, Fig. 2, previously made in another press, are laid in the pockets of the dial *A*. At *B* is a plain round blanking die operated in the sub-press. The sensitized tin plate is fed under this, and the round disk as it is punched out falls into one of the backs in a pocket of the dial, lying as at *W*. As the dial rotates it carries the button successively under the coaxing punch (see result at *X*), the setting-down punch (see *Y*) and the pushing-out punch. When the dial at each stroke has been rotated by the pawl on slide *F*, the pawls *G* and *H* lock it securely so that it cannot turn in either direction during the punching operation. A friction brake *K*, whose pressure is adjusted by nuts *L*, prevents the dial from running ahead when the pawl strikes it. There is a treadle lock provided for running the machine continuously.

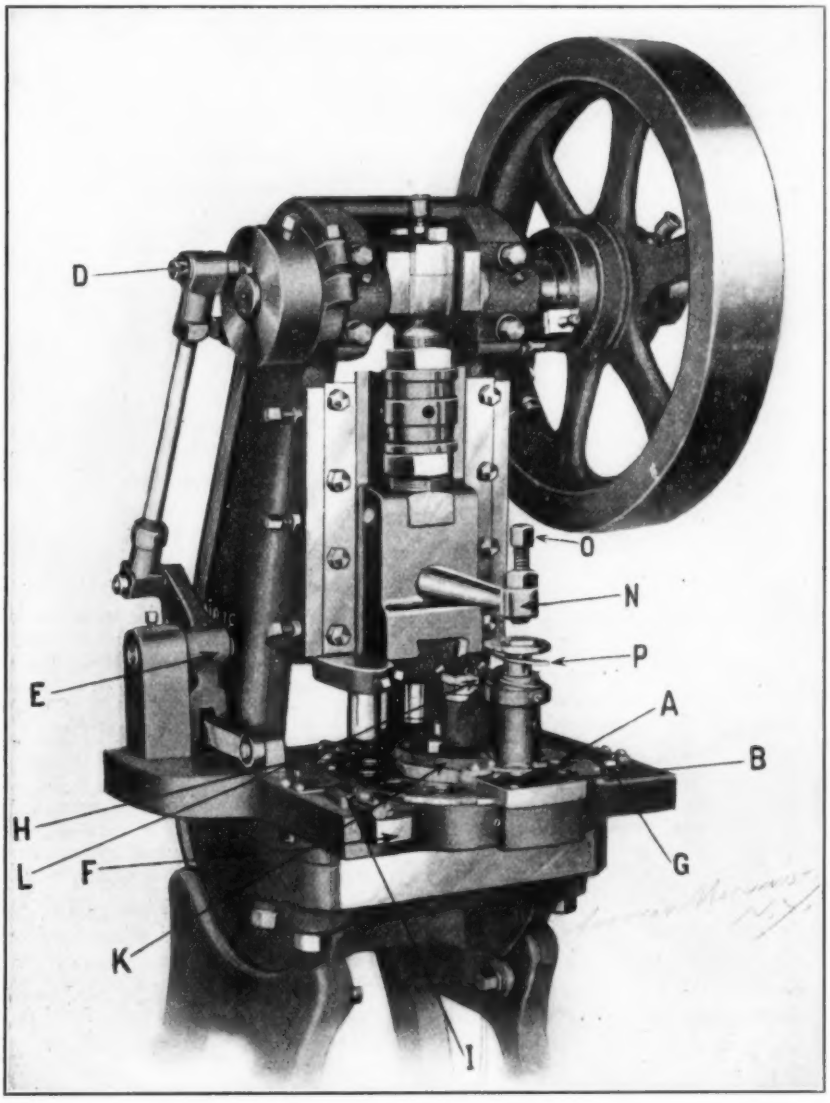


FIG. 1. AUTOMATIC PRESS FOR PHOTOGRAPHIC BUTTONS.

It is well to know that we know what we know.

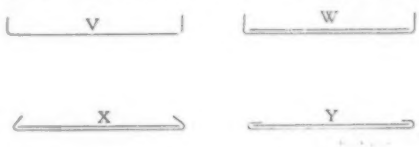


FIG. 2. OPERATIONS IN FORMING PHOTOGRAPHIC BUTTONS.

A Novel Profit Sharing Plan.

A plan of profit sharing which, so far as we know, is entirely new has been introduced by N. O. Nelson, president of the N. O. Nelson Manufacturing Company, of St. Louis, Mo., manufacturer of plumbers' supplies. Mr. Nelson has for some years shared profits with his employees and now proposes to extend the principle to his customers as well. At a banquet given to his employees celebrating the thirty-third anniversary of his presidency of the company he made the following announcement:

"I see nothing attractive in the idea of accumulating wealth, or in leaving vast piles of it when I die, or in endowing institutions. I prefer to endow individuals, rather than institutions. I think it better not only to let employees and customers of the firm have the benefits of the profits immediately which they have helped to make, but also, while I am living, to use what I already have for those purposes which I consider most needed."

The plan is described by Mr. Nelson as follows:

"We shall divide our profits beyond 6 per cent. interest on capital in the proportion of 1 per cent. on capital, 1½ per cent. on wages and salaries, and 2 per cent. to customers on the gross profits on their purchases. The profits on all our sales are figured. A ledger account will be kept with each customer, showing the amount of his gross profits, and at the end of the year footed and figured on in the same manner as the wages. In addition to this, the entire profit, without deduction for interest, on my stock, which is about four-fifths of the whole, excluding a small amount of preferred stock, which draws 6 per cent. interest and nothing more, will be divided at the rate of four-tenths to the customers, three-tenths to employees, and three-tenths for benevolent and public purposes, to be administered by me. Each customer will receive the proportion that his gross profit bears to the total gross profit. Gross profit is made the basis instead of purchase, because some goods bear much lower profit than others. These dividends will be paid in my stock of the company at a price on which the average net earnings of the next preceding three years would yield 6 per cent. net or in 6 per cent. preferred stock."

The Westinghouse Companies' Publishing Department is sending out a little pocket diary, which will be found of especial value and convenience to those who are interested in things mechanical.

Legal Notes.

BY E. P. BUFFET.

EIGHT-HOUR LAW VOID IN NEW YORK.

Another important labor case was, not long ago, decided in New York. Harry Cossey contracted to build ten scows for the city of New York and in so doing to observe the labor law so far as constitutional. He constructed and delivered six scows and the city comptroller resisted payment on the ground that Cossey had illegally permitted his men to work more than eight hours a day in the absence of emergency. The case was brought into the courts and has been decided by the Court of Appeals, which holds the provision of the law in question to be invalid under the State Constitution.

In the leading opinion of the court, written by Cullen, C. J., he points out that the case differs from the famous prevailing-rate-of-wages adjudication (People ex rel Rodgers vs. Coler) only in the respect that there the contractor had failed to pay the prevailing rate of wages and here he had permitted daily labor in excess of eight hours. It is held that the ruling in that case should be followed unless it has been overthrown by subsequent decisions in the same court or in the Supreme Court of the United States. Judge Cullen then proceeds to analyze and distinguish these later precedents. He maintains that, as in the Rodgers case, the law is unconstitutional and void.

O'Brien, J., read an opinion concurring with Judge Cullen's result, altho disagreeing with him on some points, and the unconstitutionality of the law was decided by the court, with the dissent of only Haight, J. (72 N. E. Rep., 464.)

Personal.

The A. D. Granger Company, contracting engineers of New York and Philadelphia, announces the opening of an office in the Bessemer Building, Pittsburg, under the management of E. W. Bentley, M. E.

A. L. DeLeeuw, well known to our readers as a contributor, and who for some years past has been chief engineer and superintendent of the Niles Tool Works at Hamilton, Ohio, has resigned that position. Mr. De Leeuw informs us that he has determined upon no definite plans for the immediate future.

Obituary.

John A. Weimer, president of the Weimer Machine Works, Lebanon, Pa., died February 4, forty-two years old.

Helge G. Forsburg, of Forsburg & Murray, machinists, Washington, D. C., died suddenly January 29, fifty-six years old. He came to America from Sweden as a child and had been in business in Washington for many years, doing work for the government.

Herman Dienelt, president of Dienelt & Eisenhardt, Incorporated, iron founders, Philadelphia, died February 4, sixty-eight years old. Mr. Dienelt came to this country from Germany when sixteen years old, learned the machinist trade in the shops of W. P. Uhlinger, Philadelphia, and later became superintendent of the plant. The firm of Dienelt & Eisenhardt was formed in 1874.

New Publications.

"Petrol Motors and Motor Cars." By T. Hyler White. 187 5x7½-inch pages with with 44 illustrations and 48 tables. Longmans, Greene & Co., New York and London. Price $1.50; 4 shillings 6 pence.

This book is in no sense a treatise upon motors and motor cars, but is a manual of design for use upon the drawing table, and as such it will be found useful to designers of such machines. It is very practical and can be read by anyone who is familiar with simple algebraic expressions.

"Suction Gas." By Oswald Haenssgen. 92 7x5-inch pages, 4 cuts. Cincinnati, The Gas Engine Publishing Company.

This little book has no waste words, and deals with its topic in the simplest and most direct way, so that those interested and as yet uninformed upon this latest detail of engineering economy may in an hour absorb the most important particulars concerning it. The book describes under separate heads the generator, the vaporizer, the cooler, the condenser, the purifier, the regulator, the pipes; then treats of the motor to be employed and the details of operating and caring for it, with definite information as to results obtained. The operation of a suction gas plant is thus sketched: "Air laden with water vapors is passed thru a column of red-hot coals. The carbonic acid produced by the imperfect combustion of the coals is reduced to oxide of carbon. The gas, or rather the mixture of gases, thus obtained passes thru cooling and purifying devices and then enters the engine." "In the suction gas plant the depression caused by the suction stroke of the motor extends thru the pipes and various apparatus and causes the air to enter below the grate of the generator, in order to establish the atmospheric pressure therein."

"Notes on Mechanical Drawing Introductory to Machine Design." By P. M. Chamberlain. 68 6x9-inch pages with 96 illustrations. A. C. McClurg Company, Chicago. Price, 75 cents.

This manual has been prepared for the use of students at Lewis Institute. It relates largely to the conventions which the student must acquire in order to make acceptable working drawings. A collection of methods which many draftsmen will find useful is given for drawing the ellipse, parabola and hyperbola, some of these being exact and others approximate. A brief presentation is made of the principles of toothed gearing, projection drawing and of the construction of intersections. The book concludes with a number of very effective isometric sketches of machine parts which are intended to be drawn as exercises in plan and elevation.

"Die Werkzeugmaschinen" (Machine Tools). By Hermann Fischer. Second edition, enlarged and improved. Vol. I, Metal-Working Machinery. 823 pages with 1,545 figures; 50 lithographed plates under separate cover. Size, 8x10¾ inches. Berlin: Julius Springer, Monbijouplatz, 3. Price, 45 marks.

We reviewed the first edition of this work nearly five years ago, describing it as a monument of industry, a judgment we have no desire to recall. As a treatise on machine tools we know of no modern book in English which approaches it in the magnitude of the achievement. In the present edition the former arrangement has been largely preserved and the work kept within only slightly extended bounds, but new matter has been introduced to bring the work up to date and some of the old has been retired to make room for it. There is a second volume relating to wood-working machinery which was originally published subsequent to Vol. I (including a plate volume) and which has not been sent us in the new edition. No doubt a revised edition of that also will appear in due time.

"Elementary Course in Mechanical Drawing." Part I. By A. W. Chase. 189 8½x6¾-inch pages with 97 illustrations. Howland Speakman, Chicago. Price $1.50.

The multiplication of books on mechanical drawing is of course an indication of the increasing attention which is being given to the subject in the schools. The book before us has very little to say on the subject of machine drawing, that being, presumably, reserved for Part II. The branches of the subject here taken up are the solution of geometrical problems and projection drawing.

"Manuel de la Machine a Vapeur. Guide pratique donnant la Description du Functionnement et des Organes des Machines et des Chaudières à Vapeur, a l'usage des Mècaniciens, Chauffeurs, Dessinateurs et Propriétaires d'appareils à vapeur." By Edouard Sauvage. Pp. 426, 5x7½ inches. 250 illustrations. Paris: Ch. Béranger, 15 rue des Saints-Pères. Price, 10 francs.

Hardly any other name in current French technical literature stands out more conspicuously than that of M. Edouard Sauvage, the author of this book. The volume is not the lifework of a small man, but rather the by-play of a great man. We would not, however, apply this expression to the discredit of the production, which, tho by no means heavy or exhaustive, makes a pleasing impression

as an elementary treatise on the steam engine from its first principles. The opening chapter is historical, then follow discussions of mechanical and physical laws, thermodynamic fundamentals, steam distribution, valve gears, flywheels, etc. The author passes on to explain the design of the chief machine elements and describe the leading types of engines—turbines and other rotaries not excepted. He concludes with chapters on condensation, steam production, etc.

Business Items.

In the construction of the East Boston tunnel several Ingersoll-Sergeant air compressors were used. Two low-pressure straight-line single-stage class "A" machines and one straight-line two-stage class "AC" were used for section B. For section C four Ingersoll-Sergeant Class "AC" compressors and two class "A" were used.

In our list of calendars received is to be included that of the Becker-Brainard Milling Machine Company, Hyde Park, Mass. The issue of this calendar was much delayed by a printing-house fire. Two other calendars to be acknowledged are those of Thomas Wildes, 246 Water street, and Geo. I. Roberts & Bros., 471 and 473 Fourth avenue, New York city.

E. L. Byron, who for the past twenty years has been connected with the Vulcan Iron Works Company, Toledo, Ohio, has been promoted to the position of general manager. This does not mean that Alexander Backus will retire from that place, but Mr. Byron will take much of the responsibility that has hitherto rested on the shoulders of Mr. Backus.

"A Business Proposition" is the title of a booklet gotten up by Henry C. Tulley, Wainwright Building, St. Louis, Mo., in the interest of his handbook. Anyone wishing to obtain some idea of the subjects covered by this book can do so by sending for a copy of the booklet. Tulley's handbook on engineering has had a very large sale, and is now being supplied on the installment plan.

The rapid introduction of mechanical draft as a substitute for chimney draft has been noticeable. A recent installation of considerable interest is that made by the B. F. Sturtevant Company, of Boston, Mass., for the Marquette Manufacturing Company, La Salle, Ill., where ten 150 horse-power horizontal tubular boilers have been equipped with a large engine-driven fan applied as a substitute for the chimney, to induce draft thru the grates.

The annual convention of officers and branch managers of the Crocker-Wheeler Company took place at the main office and works, Ampere, N. J., January 26, 27 and 28. Managers and representatives were in attendance from all parts of the country, and were unanimous in predicting a prosperous season during the coming year in the field of alternating-current generators and direct-current generators and motors. On the evening of the 27th a banquet was held at the Cafe Martin, in New York, at which the president of the company, Dr. Schuyler Skaats Wheeler, presided.

One of the features of the advent of electrically driven machinery has been the development of the electric fan. Originally the pulley-driven fan appeared to fulfill the requirements of the purchaser; soon, however, the steam fan with direct-connected engine displayed its utility, but to-day the fan driven by an attached motor is rapidly supplanting the steam fan. Progress along this line has been the constant aim of the B. F. Sturtevant Company, of Boston, which has been known for years as a manufacturer of fan blowers. For years past it has been gradually but surely perfecting designs and keeping abreast of the times in this branch of engineering.

The new type of magnet for handling pig iron, small billets, scrap iron or steel, small steel or iron castings, bolts, rivets, etc., in bulk, which has recently been put on the market by the Electric Controller & Supply Company, of Cleveland, Ohio, is the result of long experience and persistent experimenting to get the most efficient design. It is adapted to be carried on the hook of a crane and controlled by the crane man, who can thus perform the entire operation of loading or unloading a car, or loading melting stock into charging boxes with no ground men or helpers. This type of magnet has so obviously supplied the demand for a means of materially reducing the cost of handling such raw materials that the company is experiencing a heavy call for it. The design of this magnet is radically new, and is covered by letters patent.

The International Committee of the St. Louis Exposition recognized the engineering ability of the designers of the apparatus exhibited by the General Electric Company in awarding grand prizes as follows: To Elihu Thomson, for various applications of electricity; also to C. P. Steinmetz, for electric lighting, and to F. J. Sprague, for application of electricity to transportation. They have also awarded gold medals to C. G. Curtis, the originator of a successful American multi-stage steam turbine; to W. L. R. Emmett, designer of the vertical type of Curtis steam turbine and generator, and to W. B. Potter, for applications of electricity to transportation. They have also awarded silver medals to W. S. Moody, for transformers; to E. M. Hewlett, for distribution of energy, switchboards, etc.; to H. F. T. Erben, for apparatus for generating electricity; to H. G. Reist, for apparatus for generating electricity; to L. T. Robinson, for scientific apparatus, measuring apparatus and laboratory standard instruments, and to F. P. Cox, for measuring instruments, indicating, recording and integrating.

The Westinghouse Electric & Manufacturing Company has closed a contract with the United Railways & Electric Company, of Baltimore, Md., for an alternating-current generator to be rated at 5,000 kilowatts. It will be of the flywheel type, with 32 poles, and will run at 94 revolutions per minute. The generator will be wound for 13,000 volts, three-phase, with a frequency of 25 cycles. The 5,000-kilowatt generator now on order is to have the same characteristics and to run in parallel with the five 2,000-kilowatt generators which the Westinghouse Company just finished installing in the Pratt street station, in Baltimore. The Westinghouse Electric & Manufacturing Company has just sold to the La Belle Iron Works, at Steubenville, Ohio, a direct-current engine-type generator, to be rated at 1,000 kilowatts, the voltage to be 250. The contract includes also a switchboard of blue Vermont marble. The Westinghouse apparatus already installed in this plant includes alternating and direct-current generators with a total rated capacity of 1,250 kilowatts, a 300-kilowatt rotary converter and over 200 motors, not including those used on the cranes ranging in size from 1 to 200 horse-power. About two-thirds of these are Westinghouse type "C" alternating-current motors.

Manufacturers.

The Oxford (N. C.) Cotton Mills will install more machinery.

The Ogden (Utah) Sewer Pipe & Clay Company will erect a new building.

The Fayetteville (N. C.) Planing Mills Company is erecting a new plant.

The Halls (Tenn.) Box Company, recently organized, will soon erect a factory.

The Otto Gas Engine Works, Philadelphia, will erect a plant in Wilmington, Del.

The Florida Ice Manufacturing Company, Jacksonville, Fla., will extend its plant.

The Banner Electric Company, Youngstown, O., will double its present capacity.

The factory of the Hyland Mattress Company, Worcester, Mass., has been burned.

The American Sheet & Tin Plate Company will enlarge its mill at South Sharon, Pa.

The Southern Pipe Company, Birmingham, Ala., will double the capacity of its plant.

The Onalaska (Wis.) Woolen Mill Company is contemplating the enlargement of its plant.

It is understood that the Dimmick Pipe Company, Birmingham, Ala., will enlarge its plant.

An addition is to be built to the shops of the Pennsylvania Railroad Company at Renovo, Pa.

Burd & Fletcher's printing plant, at Worcester, Mass., was destroyed by fire; loss, $100,000.

The Archbold-Brady Company, Syracuse, N. Y., electrical contractor, is putting up a new plant.

The Waterloo (N. Y.) Woolen Manufacturing Company will make an extensive addition to its plant.

John Bannon, ink manufacturer, of Mexico City, will probably remove his plant to Chattanooga, Tenn.

The Wisconsin Light & Power Company, recently incorporated, will erect its plant at Onalaska, Wis.

The Dunmore (Pa.) Lumber Company will enlarge its plant, putting in new and improved machinery.

The Cadillac Veneer Company, Cadillac, Mich., will increase its plant, putting in new planers and joiners.

The Field-Brundage Company, Jackson, Mich., manufacturer of gasoline engines, will erect a new factory.

The Curtis & Co. Manufacturing Company, St. Louis, Mo., will remove its factory to the suburbs of that city.

The electric light plant of the Watkins (N. Y.) Consolidated Gas & Electric Light Company has been burned.

The Menominee Electrical Manufacturing Company, whose plant was recently burned, will locate in Marinette, Wis.

The Springfield (Ill.) Electric Pressed Brick Company has been incorporated and is letting contracts for machinery.

The Anchor Tannery, Cincinnati, O., whose plant was burned recently, is securing another plant and will remodel it.

The Southside Manufacturing Company, Petersburg, Va., whose berry basket and crate factory was burned, will rebuild.

F. J. Prome, Shiloh, O., will establish a factory in Galion for the manufacture of an improved grain-cleaning machine.

W. H. Schuyler and E. H. Budinger, of Chicago, Ill., will build a factory for linotype repairing work at Traverse City, Mich.

The stone, saw and carving mills of the George Henley Stock Company, Stivesville, Ind., have been burned; loss, about $12,000.

Manuel Alonzo, of Vera Cruz, will establish an electric power plant on the Antigua River at a point about 18 miles from that city.

The Jackson Fibre Company, Bemis, Tenn., will practically double the capacity of its plant. About $400,000 will be expended in improvements.

The Kokomo (Ind.) Buncher Company has been formed, with a capital stock of $50,000, to manufacture a clover buncher invented by N. G. Hanna, president of the company.

The Hydro-Carbon Manufacturing Company, Denver, Colo., is remodeling a woolen mill for manufacturing its products, and, it is said, will put up a new building later.

The Lookout Planing Mills, at Chattanooga, Tenn., is making additions to its plant.

The sawmill of Prouty & Miller, Bigelow, Me., has been destroyed by fire. It probably will be rebuilt.

It is reported that a meeting of the directors of the Turner Heater Company, of Bristol, Conn., was held for the purpose of taking action regarding the rebuilding of their factory, which was recently burned.

The Commonwealth Company, a merger of six electrical companies of southern Michigan, will erect a $100,000 power plant in Jackson, Mich. W. A. Foote, of the latter place, is conversant with the details.

A 50-ton mill will be built for the Gold Dirt Mines & Milling Company, in Gambell Gulch, near Rollinsville, Colo. McFarlene & Co., of Central City, have the contract for the erection and equipment of the mill.

Work was commenced on the erection of the immense electrical department of the new $10,000,000 plant at McKeesport, Pa., that will supply the power for the operation of the National Tube Company's plant.

It is reported that the city of New Orleans has decided to readvertise for bids on the machinery for the new pumping station there. This action, it is claimed, is due to a flaw in the first advertisement for bids.

The Chesapeake & Ohio Railroad Company is contemplating building a plant in one of the Southern cities, not yet decided upon. Superintendent of Motive Power J. F. Walsh, Richmond, Va., says the new plant will cost $1,000,000.

The Otis Elevator Company has awarded the contract for the erecting of the first building of the factories to be erected in Houston, Tex. General Manager M. H. Robbins, of the latter place, is in charge of the installation of machinery, etc.

The Tindel-Morris Company, Eddystone, Pa., is putting up a new factory, where it will manufacture saws and metal-cutting tools, etc. A new company, with practically the same officers as the Tindel-Morris Company, has been formed and will apply for a charter. It is to be known as the High Duty Saw & Tool Company.

The new plant at Ithaca of the Morse Chain Company, of Trumansburg, N. Y., will consist of machine shop, forge shop, hardening and tempering shop, wood shop, pattern storage, foundry and offices. The power plant will consist of Westinghouse single-acting compound engines direct connected to 80-kilowatt, 125-volt, direct-current generators from the St. Louis Exposition, supplied by Babcock & Wilcox boilers at 130 pounds pressure. The machine shop equipment will be modern in every respect, with individual and group drives from 110-volt motors. Work of completing the details is now progressing rapidly preparatory to commencing work of erection in the spring.

New Catalogs.

Wilmarth & Morman Company, Grand Rapids, Mich. Circulars 86, 87 and 88 of New Yankee drill grinder. Illustrated.

National Electric Company, Milwaukee, Wis. Bulletin No. 400, describing Lundell universal motors. Illustrated. 7½x10½, paper.

Foote, Burt & Co., Cleveland, O. 1906 catalog of multiple-spindle drills, containing very complete description, tables, specifications, etc. Illustrated. Pp. 70, paper.

Rochester Die Shaper Company, Rochester, N. Y. Pamphlet describing improved Rochester slotting attachment for milling machines. Illustrated. 3½x6, pp. 7, paper.

Miner & Peck Manufacturing Company, New Haven, Conn. Supplement sheet, January, 1905. New model Peck automatic drop lifter. Illustrated. 6x9½, paper.

The Robbins & Myers Company, Springfield, Ohio. Price list No. 20 of motors and generators. Illustrated with half-tone engravings and line drawings. 5½x8½, pp. 16, paper.

Hammacher, Schlemmer & Co., 133 Fourth avenue, New York. Catalog No. 262. This is devoted exclusively to bolts, screws, nuts and supplies and presents a very large variety of this class of goods; contains numerous illustrations, has 194 pages and is bound in cloth.

Rand Drill Company 128 Broadway, New York. Catalogs Nos. 10 and 11 of Imperial air compressors; 6x9, paper. Catalog "C," fourth edition, air and gas compressors; 6x9, paper. These catalogs are printed on very fine coated paper, contain very complete descriptions, tables and excellent half-tone illustrations.

H. W. Caldwell & Son Company, Chicago, Ill. General catalog No. 28; 736 pages, including index; 6x9½, cloth. This gives complete and concise information about the various articles manufactured by this company, including conveyors, friction clutches, elevating machinery, power-transmitting machinery, Caldwell-Walker machine-molded gears and many other specialties of use to shop owners. The catalog is printed on good paper, with half-tone and wood engravings, outline engravings being used, where necessary, to show sizes and dimensions. Tables and price lists are also included.

Miscellaneous Wants.

Advertisements will be inserted under this head at 25 cents a line each insertion. Copy should be sent to reach us not later than Saturday morning for the ensuing week's issue. Answers addressed to our care will be forwarded.

Caliper cat. free. E. G. Smith, Columbia, Pa.

Punches & dies. Wal.M.Wks., Waltham, Mass.

Light mach'y to order; model work; rubber molds. J. W. Weir, Bridgeport, Conn.

Will buy or pay royalty for good patented machine or tool. Box 282, AMER. MACHINIST.

Light and fine mach'y to order; models and elec. work specialty. E. O. Chase, Newark, N. J.

A set of steel figures, size 3-32 or ⅛ in.; $1.25, post paid. J. L. Lucas, Bridgeport, Ct.

Wanted—Useful specialties or machine parts to manufacture. Ryall Screw Works, Montreal, P. Q., Canada.

Designs and shop drawings properly executed by Geo. Schwarz & Co., Room 604, 150 Nassau st., New York.

Salesmen of machinery supplies to handle "Lang's T-bolt heads" on commission. G. R. Lang Co., Cincinnati, O.

Automatic machinery designed and constructed by the Wellman Sole Cutting Machine Co., Medford, Mass.

Wanted—6 ft. gang punch, also a set of plate-bending rollers from 4 to 6 feet long. Box 292, AMERICAN MACHINIST.

Wanted—Machines to build, or other articles in the machinist line to manufacture; also experimental work done. A. Johnson, 18 Dunham Pl., Brooklyn, N. Y.

The Canada Machinery Company, Limited, Sarnia, Canada, have the facilities and are open to manufacture, for patentees and others, machines and machinery for the Canadian market.

Wanted—To furnish competent men for positions as managers and heads of departments in the metal-working or machine business and the past experience of each, for which there is no charge; also want competent men to register for such positions. Address James Brady, 168 Lefferts Place, Brooklyn, N. Y.

Business Opportunities.

Superintendent, architectural draftsman, also an estimator on architectural work, wanted for well-known, prosperous manufacturing company; investment $3,000 to $5,000 required; secured to satisfaction. Business Opportunity Co., 1 Union Sq., New York.

For Sale.

For Sale—Long-established machine shop in this thriving city; cause of sale, death in firm. W. D. Judson, New Haven, Conn.

For Sale—A machine shop; price $3,500; business shows for last year 11 per cent. net profit on the inventory. Address Box 277, AMERICAN MACHINIST.

For Sale—U. S. patent No. 770,722, 1904; machine for making wire nettings; in fact, cheapest and strongest fabric in market, and now giving good results in Europe. Box 301, AMERICAN MACHINIST.

I can sell your machine shop (or other business), with or without real estate, no matter where it is or what it is worth. Send description, state price and learn how. W. M. Ostrander, 111 North American Bldg., Philadelphia.

Factory property for sale or rent at Plainfield, N. J.; building, 24 by 60; 15 H.-P. Fairbank-Morse gasoline engine, shaft and belt; lot 200 by 200, with railroad siding; immediate possession. Apply A. J. Brunson, Plainfield, N. J.

For Sale—United States patent No. 719,854, 1903, for best water gage in the world; now giving splendid results on English market; see description on page 788, December issue of POWER. Apply James Robinson, G. P. O., Leeds, England.

For Sale—A modern machine shop, complete with water power, suitable for manufacturing and jobbing purposes; is now running at Londonderry, Vt.; cause of selling, death of proprietor. Address Mrs. H. A. Hayward, Londonderry, Vt.; or Kansas City Machine Works, Kansas City, Mo.

Wants.

Situation and Help Advertisements only inserted under this head. Rate 25 cents a line for each insertion. About six words make a line. No advertisements under two lines accepted, and no advertisements abbreviated. The cash and copy should be sent to reach us not later than Saturday morning for the ensuing week's issue. Answers addressed to our care will be forwarded. Applicants may specify names to which their replies are not to be forwarded; but replies will not be returned. If not forwarded they will be destroyed without notice. Original letters of recommendation or other papers of value should not be enclosed to unknown correspondents. Only bona-fide situation want or help want advertisements inserted under this heading. Agency advertisements must be placed under Miscellaneous Wants.

Situations Wanted.

Classification indicates present address of advertiser, nothing else.

CONNECTICUT.

Position wanted by A1 toolmaker, capable taking charge of experimental or tool department; best of references. Address, with particulars, Box 299, AMERICAN MACHINIST.

ILLINOIS.

Broadly qualified machine works general superintendent, desiring new location, invites confidential inquiries; state particulars. "Conservant," care AMERICAN MACHINIST.

Superintendent, age 34; wide experience manufacturing small and medium sized machinery, tools and metal specialties; knows how to handle men and turn out work; highest references. Box 248, AMER. MACHINIST.

Permanent position, by quick estimator and competent designer of inventive and executive ability; traveling cranes, elevators and general hoisting machinery; qualified to start concern in these branches; references; location immaterial; technical education. Box 273, AMERICAN MACHINIST.

MASSACHUSETTS.

Mechanical engineer, acquainted with production of petrol motors; tools for rapid reproduction specialty; good record. Address Box 308, AMERICAN MACHINIST.

Competent mechanic, designer of tools and machinery for manufacturing; accurate, rapid reproduction specialty; good manager of men. Address Box 306, AMERICAN MACHINIST.

General repairs work wanted by a man of 15 years' experience on repairs in woolen mill, lathe, bench and carpentering work; can go on short notice. Box 298, AM. MACH.

Superintendent or foreman, forge shop; bolt and nut product; forgings of all descrip-

The United States Arsenal at Rock Island—IV.

BY F. A. STANLEY.

When the general plan of Rock Island Arsenal was mapped out over forty years ago, it was recognized by the government that eventually a second small arms plant would be necessary to supplement the work of the Springfield Armory; so one row of shops—that to the north of Main avenue—was erected for this special purpose. And curiously enough, as it now seems, the first of the ten buildings to be completed was the one at the head of Armory Row—shop B which, as matters turned out, was to be unoccupied by manufactures for a score and a half of years.

INSTALLATION OF THE SMALL ARMS PLANT.

Most of the 1,400 machines now in Armory Row were installed by 1902; the first department fitted up—as I learned from the master mechanic, George Patterson, with whom, as with the chief draftsman, Geo. F. Summers, I spent many interesting moments during my visit—being the machine shop in shop D, this enabling any machine work required during the installation, to be done on the spot. About this time, however, a change in the type of rifle for the army was

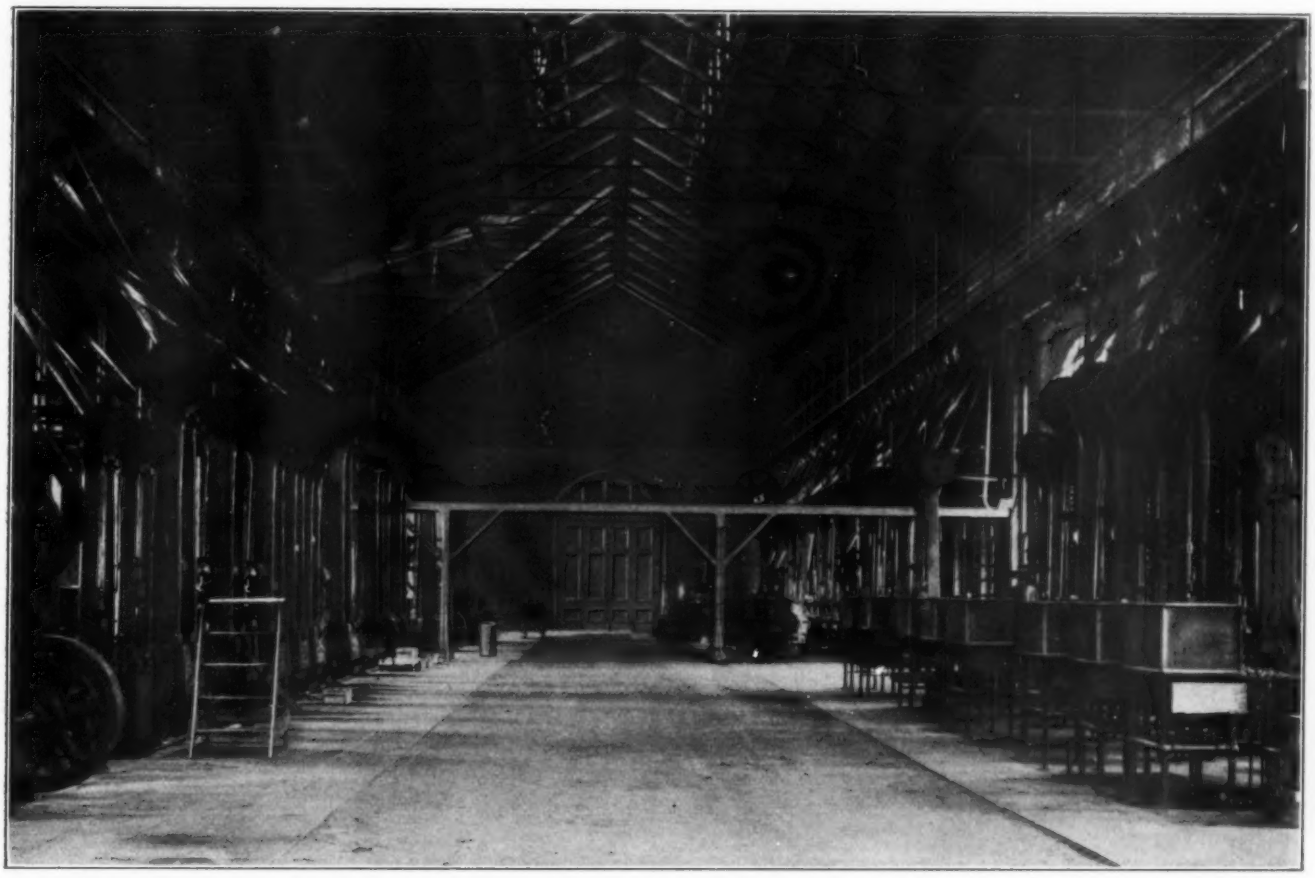


FIG. 29. THE DROP-FORGE SHOP.

For not until war opened with Spain and difficulty was encountered in supplying the army with modern rifles, did the real necessity for the immediate establishment of an additional small arms factory become apparent to Congress. Then in 1899 a moderate appropriation was made for the equipping of some of the shops in Armory Row with machinery, and the following year the sum voted by Congress for this purpose was increased to well toward a million dollars, and work was commenced at once toward putting in electric power and getting three of the buildings in shape for machinery and workmen, and contracts were shortly after let for machinery sufficient to produce about 225 rifles per day.

under consideration, hence nothing could be done toward getting out the numerous special tools and fixtures essential to this class of work until the design of the new rifle was fully settled. A year and a half ago it was decided by the Ordnance Department to adopt the arm now known as the "U. S. magazine rifle model 1903" and to carry on its manufacture at both Springfield and Rock Island. So gages to insure the interchanging of parts made at the two factories were gotten out at the former place for use in both establishments, and fixtures constructed sufficient to allow the Rock Island plant to be operated at about one-half its capacity, as it was decided for the time being at least to limit the output of the latter establishment to about 125 rifles per day.

To assist in the starting up of this new work at the arsenal fifty or more foremen, toolmakers and others from the Springfield Armory have been transferred to Rock Island for longer or shorter periods, D. J. Manning, well known in connection with the above armory, acting as general foreman under Capt. Jno. T. Thompson, the ordnance officer directly in charge under Colonel Blunt. Gradually workmen have been taken on and instructed in the special operations of small arms construction until now about 700 men are employed in the three shops, and it is expected that by the end of a few months more the force will have increased to eight hundred operatives and the required daily output of 125 rifles will have been reached.

THE DROP FORGE SHOP.

The mechanical equipment of the three shops is a splendid one—a statement which will be borne out by numerous engravings here and in following articles, showing long rows of "Lincoln" millers, profilers, screw machines, lathes, and special gun machinery. And one of the most interesting of the departments is the drop forge shop, where so many of the members of the rifle, such as the receiver, the breech bolt, guard, trigger, etc., are forged and made ready for the different operations carried on in the various ma-

chine departments. A view in this shop, which occupies the west wing of the building F—the central one of the row—is given in Fig. 29, and here will be seen two rows of Billings & Spencer board drops, several helve hammers, trimming presses, etc. There are over forty drops operated under the two lines of shafting and each shaft is motor driven. The furnaces, like those for the annealing and case-hardening department in the same building, use crude oil fuel.

ANNEALING AND CASE-HARDENING PLANT.

A view of the furnaces in this department with oil tanks and dipping apparatus for the work is given in Fig. 30. There are eight copper tanks in the group, each 3 feet in diameter by 3 feet deep, and overhead is an I-beam with trolleys which carry the tackle for suspending the work in the oil. With the two batteries of Rockwell furnaces are used two pneumatic pyrometers, one of which will be noticed leaning against one of the furnaces, and the temperature readings are taken automatically by a Steinbart recording gage in the small office located beyond the row of oil tanks. At the rear of the furnaces are several tanks for bluing rifle parts. Among other appliances in this building is a set of rolls for rifle barrel stock, the material being first run thru the rolling mill and then cut off roughly to length by a pair of cold saws mounted on one arbor. The work handled in this shop is easily conveyed to the finishing shops, or *vice versa*, thru the subways under the cross streets, an elevator shaft being located near each entrance to the tunnel.

THE GUN BARREL DEPARTMENT.

This branch of the establishment is on the first floor of the west wing of shop B and a number of photographs of interesting groups of machines therein are herewith reproduced. Thus in Fig. 31 is shown a battery of some forty special lathes of Garvin and F. E. Reed makes, for turning up the barrels; and a view a little further up this side of the room is given in Fig. 32, where are represented a number of turret machines for rounding the barrel muzzle and chambering the breech after drilling, and several millers for machining the lugs which locate the sight studs on the barrel. In the central aisle will be noticed a millwright traveling platform of the type mentioned in a previous article.

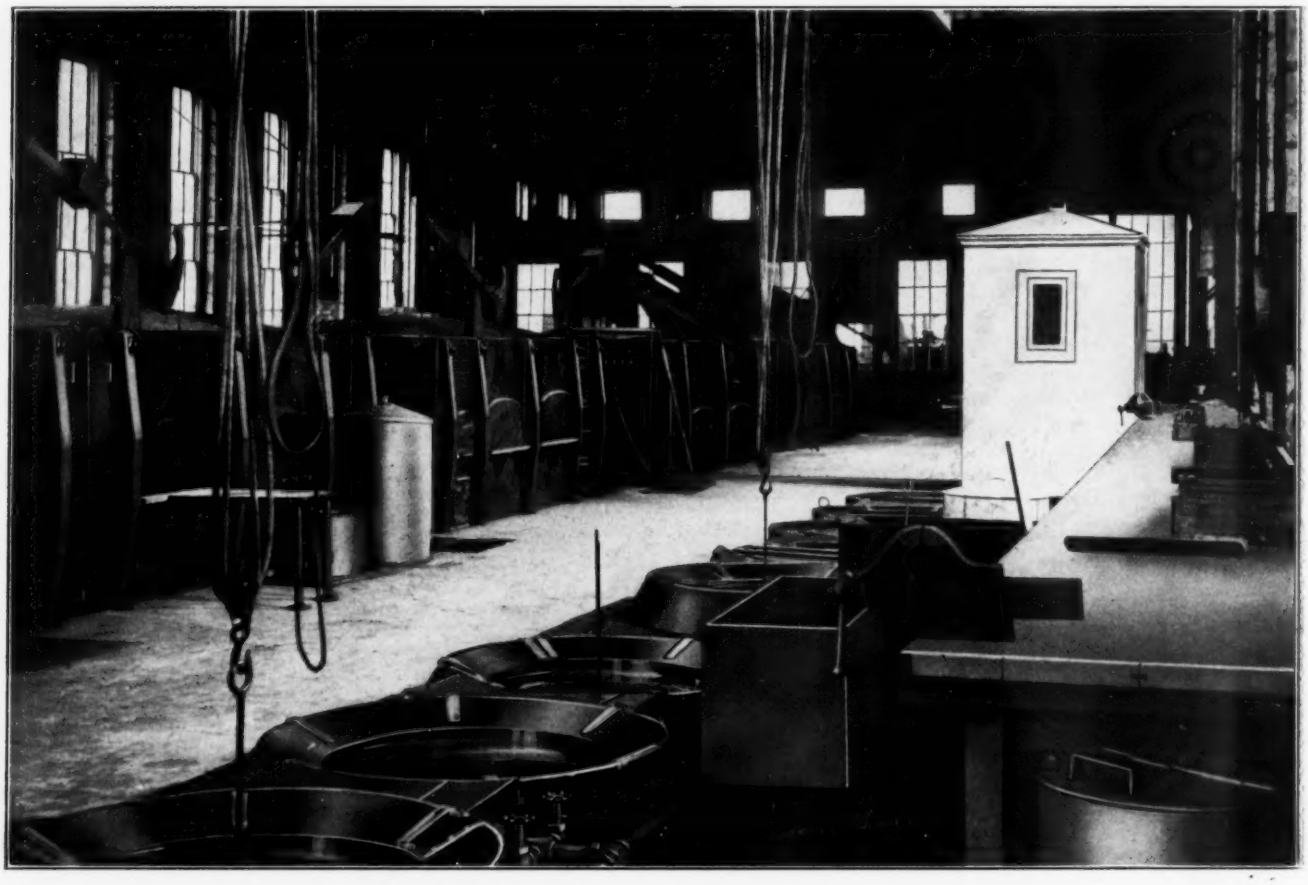


FIG. 30. ANNEALING AND CASE-HARDENING DEPARTMENT.

DRILLING, REAMING AND RIFLING MACHINERY.

Figs. 33 and 34 illustrate from opposite ends of the line a row of Pratt & Whitney gun-barrel drillers, and Fig. 35 shows a row of rifling machines by the same firm and located in the same row with the drillers; there are nineteen machines in the first group noted and twenty-eight in the battery of riflers. The three machines in the foreground of Fig. 34 are gun-barrel reamers built at Springfield, and in another section of the room there are six reamers of Diamond Machine Company manufacture. The action of these different machines is, of course, too well known to require description here. The new rifle barrel which they handle is 24 inches long and .30 calibre, and its rifling consists of four grooves 0.004 inch deep and having a uniform twist of one turn in ten inches. The barrel straighteners work at the north end of this department and in the two end windows beyond the drillers in Fig. 34 will be seen squares of ground glass which are provided with a black horizontal line toward which the expert straightener sights the barrel and by the reflection cast thru the bore determines whether the barrel is crooked, and if so, at what point it needs to be struck with his hammer.

OTHER GUN BARREL MACHINERY.

There are of course in this department a number of machines not brought out in the photographs, such, for example, as screw machines for special operations, sensitive drills with their jigs, etc. Then there are a pair of thread millers for cutting the thread on the barrel to fit the receiver; and for finishing the exterior of the barrels there is a group of five Brown & Sharpe universal grinders. Some of these are provided with adjustable former bars, which, as the wheel passes along the work, act upon the wheel stand in pre-

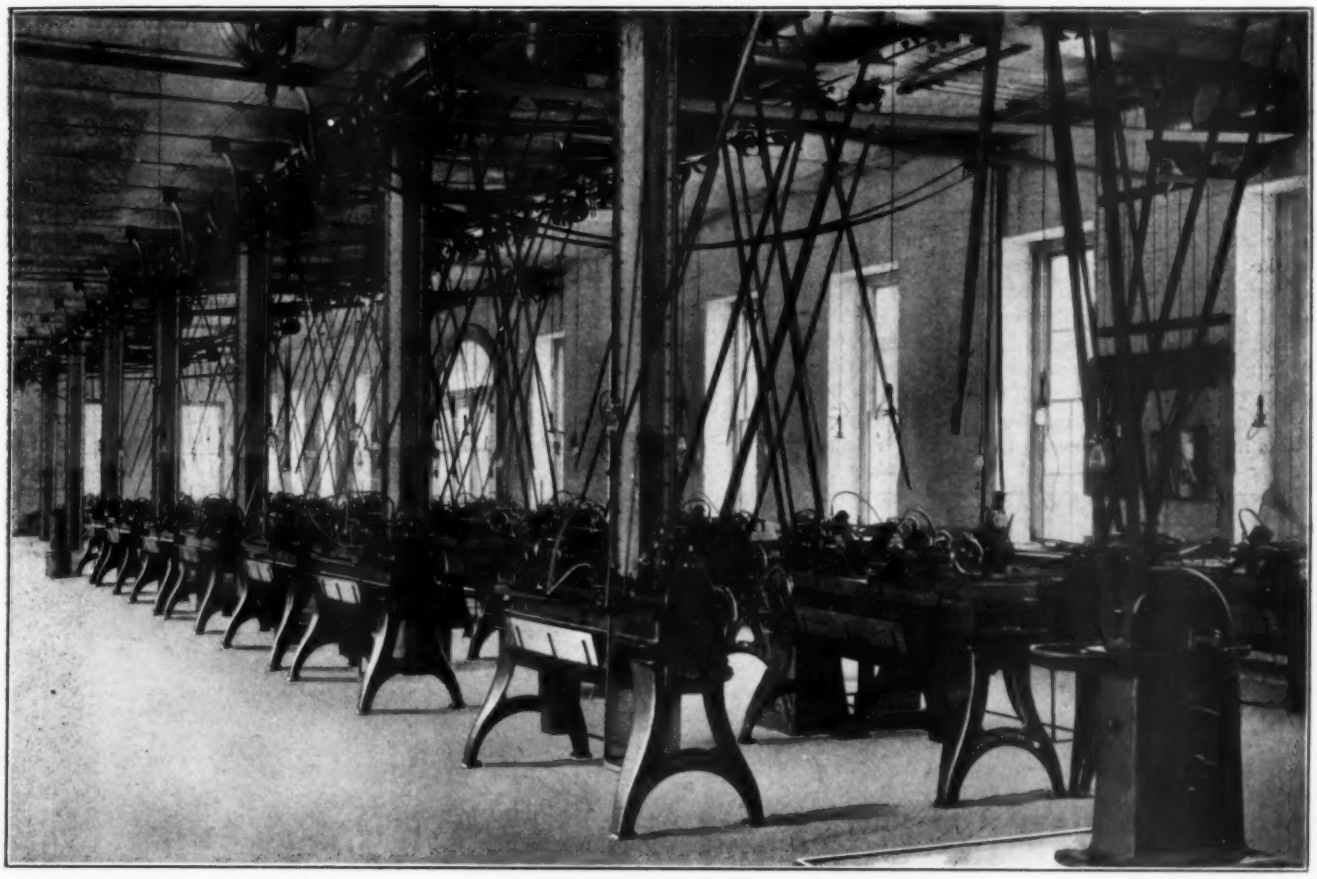


FIG. 31. BARREL-TURNING LATHES.

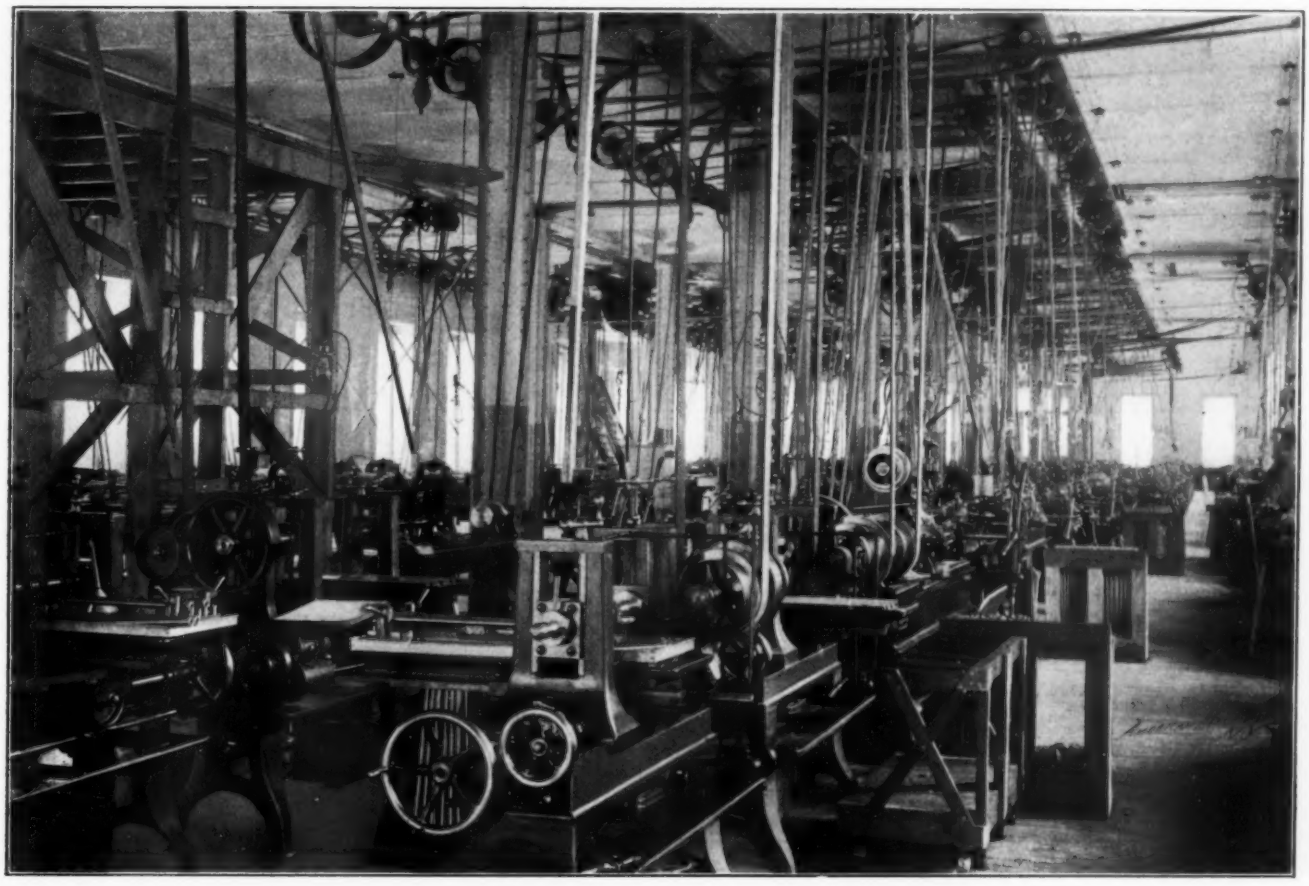


FIG. 32. MILLERS AND SCREW MACHINES IN BARREL DEPARTMENT.

cisely the same manner as the taper bar of a lathe controls the cross-slide, thus causing that portion of the barrel between the straight ends to be ground to the exact shape required.

Phenomenal Rascality.

An astonishing experience is narrated in the latest issue of *The Locomotive*, published by the Hartford Steam Boiler Inspection and Insurance Company. Several bolts were ordered removed from a new system of piping in a large steam plant. "These bolts were used to join pipe flanges, and it was found that quite a number of them were too short, so that it was impossible to screw up the nuts upon them sufficiently to make the bolts enter more than from one-half to two-thirds of their depth. When this defect was observed by our inspector, and notice of it was given to the contractors, a workman was sent to replace the short bolts with others of proper length. The piping ran across the upper part of the boiler-room, and the air about it was exceedingly hot and uncomfortable, so that the task of replacing the bolts was a very unpleasant one. The workman brought the required number of bolts, but not liking the task of putting them in properly, he sawed off stub ends from them, and ran these stub ends into the nuts that were already on the pipe, so that the stubs projected one or two threads. To a casual observer it would appear, after this operation, that the old bolts had been replaced by others of proper length, and our inspection department was notified that this had been done. Our inspector, accompanied by the chief engineer, then made a further examination of the piping, so that he could certify, from his own personal knowledge, that everything had been put into proper condition. Upon close examination it was observed by the inspector that the projecting ends of the bolts showed marks as tho a hacksaw had been used upon them. There would be no objections to the bolts projecting a little too far thru the nuts, and as the air was very hot and uncomfortable about the pipe line, it was impossible to understand why the workman should have taken the trouble to cut off any such projection that might have been left. A still closer examination followed, and it was found that all of the short bolts, to which we had objected, still remained in the pipe flanges, with these stub ends made into the nuts. It is needless to say that the contractors, upon being notified of the state of affairs, immediately had the work done right, and we have no doubt that they dealt properly and justly with the workman who did the rascally job, and who had preferred to take chances of serious accident, destructive alike to life and property, rather than to subject himself to the temporary discomfort involved in doing the work as he knew it should be done."

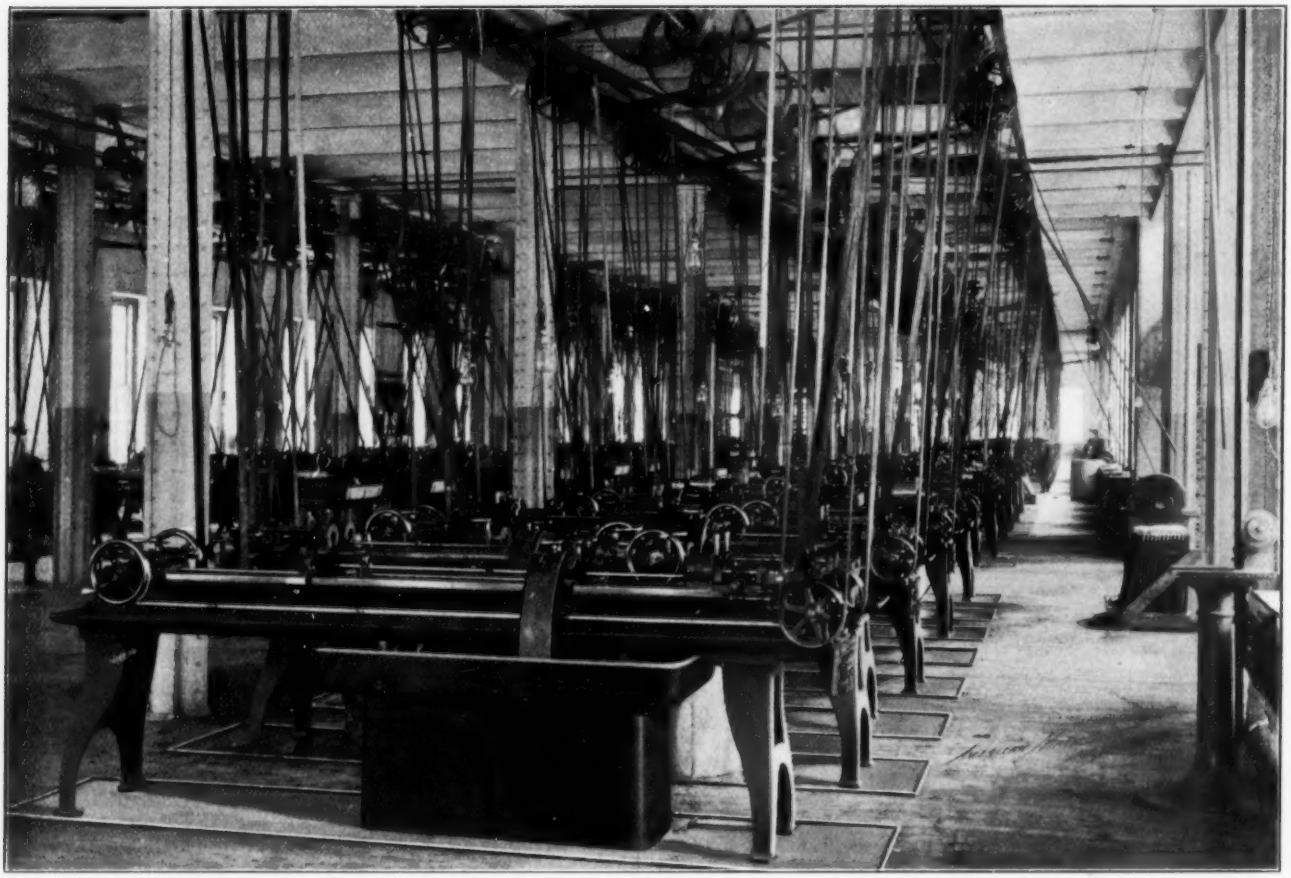


FIG. 33. A GROUP OF GUN-BARREL DRILLERS.

The Elephant and the Spider—Flying.

An interesting lecture, of which we have an abstract, was delivered recently by Dr. Archibald Barr, professor of engineering in Glasgow University. Dr. Barr pointed out nature's methods of giving a large structure the power of bearing its own weight, pointing out that the legs of the elephant were much thicker in proportion than those of the spider, and directly under its body, while the spider's were of a spreading nature. The straightness of the limbs was even more exaggerated in the case of the mammoth than of the elephant. The skylark was taken as an example of an exceedingly thin-legged bird, the lecturer remarking, in reference to the dodo, that when the limbs were small in diameter they were also short, the same rule applying to engineering structures. Cases in point were given, the lecturer expressing the opinion that Sir Benjamin Baker, with all his genius, could not build a bridge two-thirds of a mile long, there being a limit to the possible size of such structures. Turning to the question of flying, Dr. Barr remarked that the larger the body falling thru the air the stronger did it require to be in order to bear the

FIG. 34. GUN-BARREL DRILLERS. REAMING MACHINES IN FOREGROUND.

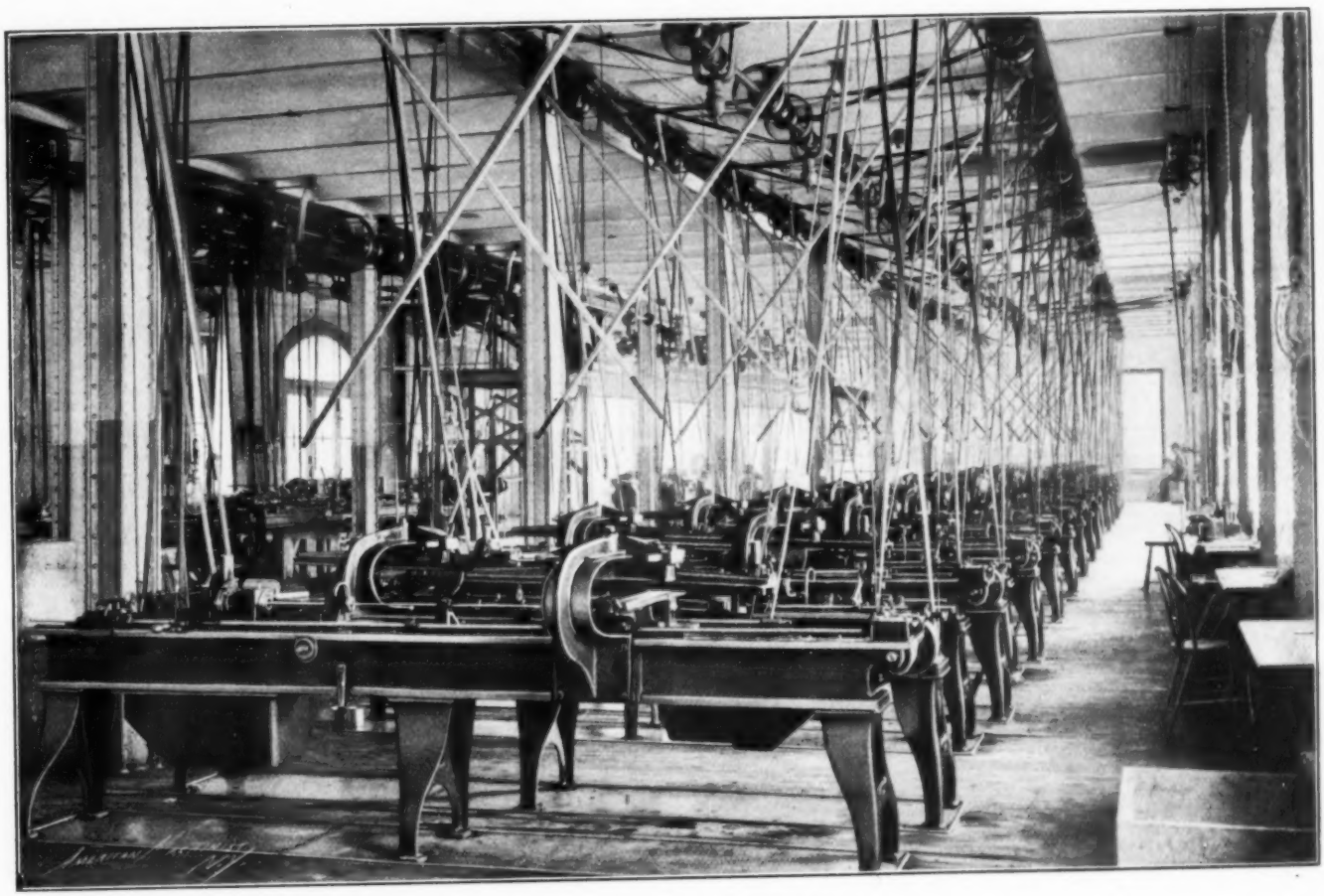


FIG. 35. A LONG ROW OF RIFLING MACHINES.

pressure coming down. Thus was a large bird always heavier in proportion to its size than a small one. Nature had never made a large creature that flew. The ostrich, for example, could not possibly have sufficient muscular power to enable it to fly. It was therefore clearly impossible that man—who was considerably larger than the albatross, perhaps the largest known flying bird—could ever provide himself with wings which would enable him to fly. Many people had made models of a flying machine, but, so far, Mr. Maxim was the only one who had tried it on a large scale, and he had not tackled the question of maneuvering the machine. This question was one of enormous difficulty, and the speaker had little confidence in the assertion that we would soon see flying machines in use.

In a Western newspaper a reporter gives an account of a new locomotive having what he calls a "monkey motion," this monkey motion being designed to give motion to the valves by means of which it is claimed that there is no back pressure in this locomotive, and that it will save from 25 to 40 per cent. in coal consumption. If this monkey-motion engine will save anything like that amount of fuel it is a very valuable thing, and deserves to have a much more dignified name.

"To compare him with a machine, he was less of the sledge hammer than of the hydraulic press. That came from the circulation of the blood, great and generous, slow and insensible."—*Jules Verne.*

Design for a Magnetic Brake for a 15 Horse-Power, 500-Volt Motor.

BY R. A. GREENE.

Assume as in Fig. 1, diameter brake wheel = 10 inches, face brake wheel = 3 inches, length brake shoes = 6 inches, dimensions A and B = 5 inches, dimensions C = 7 inches. Brake shoes, maple. P_1 = 200 pounds.

Spring.

$P_2 \times 12 = 200 \times 5$.

$P_2 = 1000 \div 12 = 83.4$ pounds to be exerted by spring to give 200 pounds at P_1.

Kent, page 349.

W = 104 pounds = safe load.

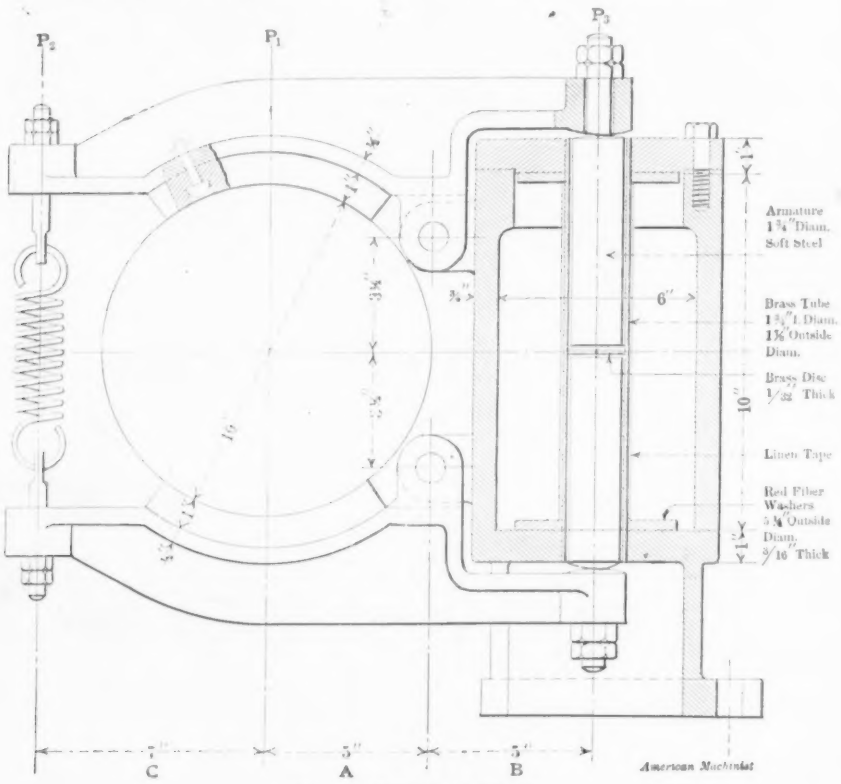


FIG. 1. SECTION OF BRAKE.

D = 1.5 inches = outside diameter.

d = .18 inch = diameter wire.

F = .146 inch = deflection per coil for each 100 pounds, E = 12 millions.

Try 10 coils.

$.146 \times 10 \times .834 = 1.217$ inches = deflection of 10 coils for 83.4 pounds.

$\frac{1}{8} \times \frac{12}{5} = \frac{12}{40} \times .3$ inch additional deflection to release each block $\frac{1}{8}$ inch.

$1.217 + .3 = 1.517$ inches = total deflection of 10 coils.

$\frac{.146}{100} \times 10 = .0146$ inch = deflection 10 coils for one pound.

$1.517 \div .0146 = 104$ pounds required at P_2 to release blocks.

If 3-16 inch spring wire is used,

$.1875 \times 10 = 1\frac{7}{8}$ inches = length of spring closed.

$1.875 + 1.517 = 3.392$ inches = length of spring open.

Magnet.

$P_3 \times 5 = 104 \times 12$.

$= 1248 \div 5 = 249.6$, say 250 pounds to be lifted by coil.

Let B = 90,000 lines per square inch,

p = pull in pounds per square inch,

$p = B^2 \div 72{,}000{,}000$.

$= 90{,}000^2 \div 72{,}000{,}000$.

$= 8{,}100{,}000{,}000 \div 72{,}000{,}000$.

= 112 pounds per square inch area of armature.

$250 \div 112 = 2.23$ square inches required.

Use 1¾-inch soft steel rod; area = 2.4 square inches.

$N = 90{,}000 \times 2.4 \times 1.1 = 237{,}600$ = total flux + 10 per cent. for leakage.

Magnetic Circuit.

Gray iron shell as shown in Fig. 2.

Area 7.5 inch circle = 44.18

Area 6 " " = 28.27

A_1 = 15.91 square inches.

L_1 = 11 inches = length of path in shell.

$B_1 = 237{,}600 \div 15.91 = 14{,}350$.

$At = 21 \times 11 = 231$ ampere turns for shell

Ends.

Area at a, Fig. 3 $= 6.75 \times 3.14 \times 1 = 21.2$ square inches.

$Ba = 237{,}600 \div 21.2 = 11{,}200$ lines per square inch.

$L_2 = 2.43 + 2.43 = 4.86$ inches.

$At = 19 \times 4.86 = 92.2$.

Area at $b = 1.875 \times 3.14 \times 1 = 5.89$.

$Bb = 237{,}600 \div 5.89 = 40{,}300$.

$L_2 = 4.86$.

$At = 102 \times 4.86 = 496$.

$A l_2 = \frac{92.2 + 496}{2} = 294$ ampere turns for two ends.

Armature, Soft Steel.

$A_3 = 2.4$ square inches.

$B_3 = 237{,}600 \div 2.4 = 99{,}000$.

$L_3 = 11$ inches, say.

$At = 95 \times 11 = 1040$.

Air Gaps in End of Shell.

$A_4 = 5.89$ square inches, same as b, Fig. 3

$B_4 = 40{,}300$ lines.

$L_4 = \frac{1}{16} + \frac{1}{16} = \frac{1}{8}$.

$At = 40{,}300 \times \frac{1}{8} \times .3133 = 1.580$.

Gap at Center.

$A_5 = 2.4$ square inches, same as b, Fig. 3

$B_5 = 99{,}000$ lines.

$L_5 = 3/16$.

$At = 99{,}000 \times 3/16 \times .3133 = 5{,}800$.

Total Ampere Turns.

231 shell,
294 ends,
1,040 armature,
1,580 end gaps,
5,800 center gaps,

8.945 total ampere turns.

To make brake release with 10 amperes, $8{,}945 \div 10 = 894$ turns.

Size Magnet Wire.

$\frac{15 \times 746}{500} = 22.4$ amperes at 100 per cent. efficiency — 15 horse-power.

$22.4 \div .85 = 26.3$ amperes at 85 per cent. efficiency.

As the current flows only 2 or 3 minutes at a time, we may use a rather high current density, say 500 circular mils per ampere.

$26.3 \times 500 = 13{,}150$ circular mils,
say No. 9 B. & S. = 12,996 cir. mils.

Use No. 9 double cotton covered; outside diameter = .126 inch. (Roebling.)

9.625 inches between fiber washers.

$\frac{5\frac{1}{4} - 1\frac{7}{8}}{2} = 1.6875$ = space for thickness of coils.

$9.625 \div .126 = 76.3$ spaces = 75 turns per layer.

$1.6875 \div .126 = 13.4$, say 14 layers because of bedding.

$75 \times 14 = 978$ turns.

SPRINGS.

It will be noticed that a spring was chosen whose safe load was considerably higher than P_2 in order to have a spring to stand the maximum deflection. If we had chosen a spring whose safe load was 83.4 pounds the spring would be strained to its maximum when the blocks were clamped on the wheel and would not have allowed the deflection required to release the blocks without being overstrained.

MAGNETISM.

The formula $p = B^2 \div 72{,}000{,}000$ may be derived from that given in Kent, page 1054, 1903 edition.

$$\text{Pull in dynes} = \frac{SB^2}{8\pi}$$

$$\text{Pull in kilograms} = \frac{SB^2}{8\pi \times 981{,}000}$$

$$\text{Pull in pounds} = \frac{SB^2}{8\pi \times 445{,}000}$$

S = area in square centimeters.
B = lines per square centimeter.

$$\text{Pull in pounds} = \frac{S}{6{,}452} \times \frac{B^2}{8\pi \times 445{,}000} =$$

$$\text{Pull in pounds per sq. inch} = \frac{1}{6{,}452} \times \frac{B^2}{8\pi \times 445{,}000} =$$

$$p = \frac{B^2}{72{,}000{,}000}.$$

B being taken as lines per square inch.
S = square inches.

MAGNETIC CIRCUIT.

In each part under consideration, let
A = area of part.
L = length path.
B = density = lines per square inch.
At = ampere turns required to force the lines thru the part.
$At = M \times L$.
M = ampere turns per inch of path for the density B.

M was taken from the table which has been found to agree quite closely with several that have been published. In this case an addition of 10 per cent. was made for leakage, which was supposed to take care of joints, etc.

In determining the ampere turns for the ends of the case we must take the mean of the ampere turns required for the density at the area a and the density at the area b, Fig. 3, and not for the density at the average area.

AIR GAPS.

The armature must have at least 1-16 clearance all around where it passes thru the ends of the gray-iron case, otherwise it will stick when the current is turned on.

Lines per Square Inch.	Ampere Turns per Inch Length.		
	Annealed Wrought Iron.	Soft Cast Steel.	Ordinary Gray Iron.
2,500	1.2	2	9
5,000	1.7	2.8	13
10,000	2.2	3.7	18.5
15,000	2.8	4.3	24
20,000	3.5	5	30.5
25,000	4.4	5.8	39
30,000	5.5	6.6	50
35,000	6.5	7.6	65
40,000	7.5	8.8	88
45,000	8.5	10.1	116
50,000	9.6	11.8	160
55,000	11.1	13.9	222
60,000	13	16.4	295
65,000	15.7	19.3	400
70,000	19.6	22.7	570
75,000	24.7	27	
80,000	31.2	34	
85,000	39.7	44	
90,000	50.7	57	
95,000	67	75	
100,000	91	100	

AMPERE TURNS AND LINES OF FORCE

In this case this clearance is filled with the tube, which is of brass and non-magnetic, making an air gap of ⅛ inch—*i. e.*, 1-16 at bottom, 1-16 at top.

The center gap is 3-16 inch, which releases each block 1-16 inch with 1-16 to spare. We will need to put a brass disk, say, 1-32 inch thick between the ends of the armature to prevent them from being banged up, but more especially to keep the armature from sticking, as it would otherwise do on account of the residual magnetism.

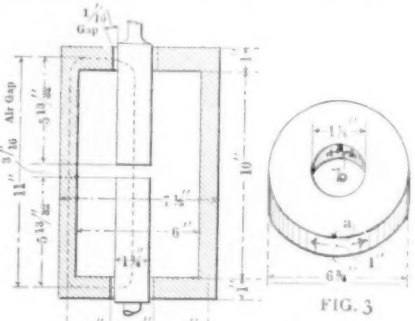


FIG. 2

MAGNETIC CIRCUIT.

FIG. 3

The ampere turns for the gap =

$$At = B \times L \times .3133.$$

This may be derived from Kent, page 1054.

$$N = \frac{1.257 \times At}{\text{reluctance}}.$$

These dimensions are in metric units.

"Reluctance" corresponds to "resistance," which varies as $\frac{\text{length}}{\text{area}}$ and equals $\frac{r \times l}{\text{area}}$, where r = resistance of a conductor 1 square unit area 1 unit long.

Reluctance = $\frac{r \times l}{\text{area}}$, where r = reluctance of a path 1 square unit area 1 unit long.

$$N = \frac{1.257 \times At}{\frac{r \times l}{\text{area}}} =$$

$$N \times \frac{r \times l}{\text{area}} = 1.257 \times At.$$

$$\frac{N}{\text{Area}} = B \begin{cases} \text{If the area is in square centimeters, then } B = \text{lines per sq. centimeter.} \\ \text{If the area is in square inches, then } B = \text{lines per square inch.} \end{cases}$$

Reluctance of air = 1.

Therefore $B \times l = 1.257 \times At$

B = lines per square centimeter or lines per square inch.

l = length in centimeters.

To change l to inches divide by 2.54.

$$B \times \frac{l}{2.54} = 1.257\ At.$$

$$B \times l = 1.257 \times 2.54 \times At.$$

$$At = \frac{B \times l}{3.192} = \frac{1}{3.192} \times B \times l = .3133 \times B \times l.$$

NUMBER OF TURNS AND SIZE OF WIRE IN COIL.

As the coil is to be in series with the 15 horse-power motor, the wire must be large enough to carry the 15 horse-power current, which at 500 volts and 85 per cent efficiency is:

$$\frac{15 \times 746}{500 \times .85} = 22.4 \text{ amperes.}$$

But if we used 22.4 amperes to determine the number of turns in the coil, then the brake would release only when the motor was working at its full load. When lowering the empty hook, power is required of the motor on account of the mechanical brake. Probably the minimum current would be required in this instance, and it was assumed that it would take 10 amperes to do this.

The current density looks rather high, but as the current was to flow but a couple of minutes at a time it was decided to risk it. The area and outside diameter were taken from Roebling's catalog of copper wire. The area may be taken from the table in Kent, page 220, but I have been unable to find the thickness of insulation for magnet wire in Kent. The number of turns that can be put in the space assigned to them is greater than the number required to release the brake at 10 amperes. This is all right, as it simply means that the brake will release with less than 10 amperes, which would be a good thing for traveling cranes. The coil not being very thick, the density was depended upon to keep the heating down, together with the short time that the coil would actually be in service. No calculations were made upon this point. This brake was in series with the motor and worked excellently. It was not intended that this brake should hold as much as the motor could do, but that it simply check the speed of the armature.

Impact Tested in Detail.

BY E. P. BUFFET.

At page 76 the AMERICAN MACHINIST gave an abstract of a paper by Messrs. Seaton and Jude on an investigation of impact as a means of testing the strength of metal. This subject is attracting attention on the Continent as well as in England. A paper has been presented to the French Society for Encouragement of National Industry by M. A. Pérot, who has undertaken some very interesting studies along that line. He agrees with the English experimenters in being impressed by the lack of relation between tensile strength and resistance to shock, but he undertakes to pry deeper into the matter than it appears they have done. In fact, he has set up an apparatus for giving a photographic record of the phenomena that take place during the exceedingly brief period when a hammer is striking. Quite aside from its present purpose this line of experiments is worthy of notice and might perhaps be followed to advantage in studying the action of a forge hammer. It is to be remarked, however, that his machine depends on the use of a spring under the place of impact, which must tend to muffle the blow and give quite different results from those which would be produced on a rigid anvil. It is fair to admit, however, that every anvil is somewhat elastic and that, theoretically at least, the sharpness of the blow can be increased to any desired amount by strengthening the spring and adapting the other parts to the machine. We may assume that in the experiments of M. Pérot a sufficient rigidity was secured for the purpose in hand. Following is an account of the work, translated, with some condensation, from his paper:

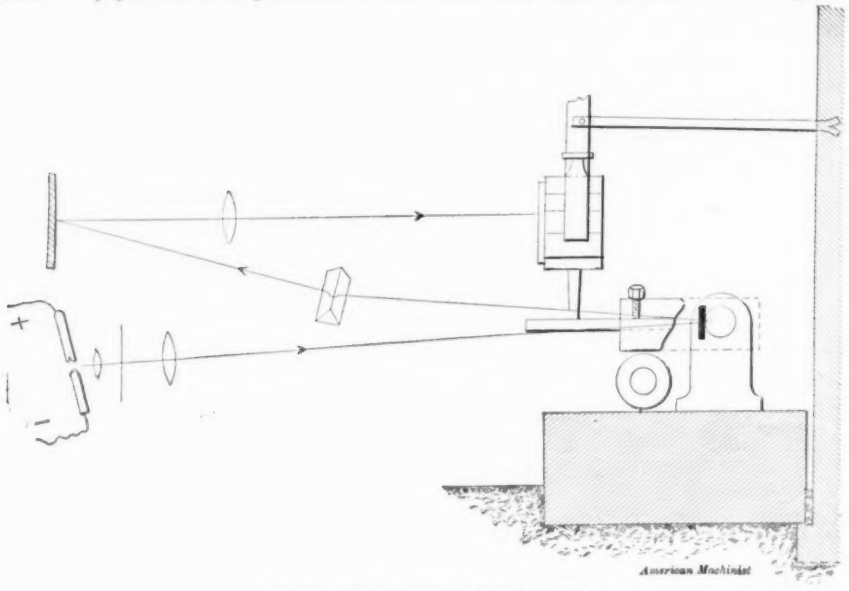


FIG. 1. IMPACT-TESTING MACHINE.

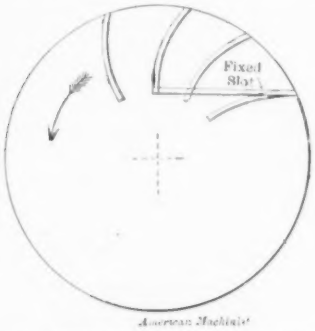


FIG. 2. TIME-REGISTERING APPLIANCE.

The test pieces are fixed at one end and struck with the hammer of the machine at about 3 centimeters from their place of clamping.

It may be supposed that there is often a direct relation between their frangibility, on one hand, and their rupturing stress or elastic limit and elongation, on the other. Samples of brittle mild steel have the peculiarity that altho their limit of elasticity and elongation are high it needs only a small number of kilogrammeters to break them under the hammer, showing a complete disagreement.

This disagreement is the subject of my investigation. Earlier impact tests which merely gave the sum of work required to break a piece did not explain the matter. So I undertook to measure the force exerted on the sample at different instants of the blow. A method which suggests itself, and which consists in registering the movement of the hammer at each instant, requires the construction of a first curve derived therefrom, giving the speed, and of a second curve derived from the former, giving the force, the course of which would necessarily be uncertain.

I thought, however, of directly measuring the forces by means of a spring, and in co-operation with M. H. Michel Lévy, carried out the idea as follows:

The test piece was fixed in an anvil block turning about a horizontal axis (Fig. 1). Under this block I placed a compression spring of hard silicon steel, calculated to have little inertia, and shaped as an annular disk. To register its deflection the axle of the block carried a mirror which reflected a beam of light to another mirror and thence to a photographic plate which was attached to the hammer and moved up and down with it. Between the two mirrors this ray passed thru a prism which gave it a horizontal displacement on the plate. So in the path of the ray on the plate, the abscissas were proportional to spring deflections and ordinates to hammer displacements.

The notches made in the test pieces were almost always flat at the bottom and quite deep. For a specimen 10 millimeters thick we sometimes left only 4 millimeters of metal. This form was convenient, for it favored permanent deformation while localizing it. We varied the width of the notch from 0.25 to 8 millimeters. The test pieces used were uniformly 120 millimeters long, 20 millimeters wide and 10 millimeters thick.

FIG. 3. IMPACT-TEST DIAGRAM.

The three sorts of curves here shown are:

FIG. 4. IMPACT-TEST DIAGRAM.

(1) A curve corresponding to a notch of 6 millimeters for an ordinary steel (Fig. 3). The vibrations are those of the whole apparatus (hammer, block, etc.) and correspond to a regular muffled vibration, the elements of which were determined by calculation. The mean curve is sensibly horizontal and even slightly convex, as if the metal were cold-hammered.

[If the illustrations are in correct position, as seems to be the case, the author, when discussing the curves, apparently regards the diagrams as turned over on their sides.]

(2) A curve corresponding to a brittle metal the tensile strength of which is 39 kilograms and the elongation 39 per cent. (Fig. 4.)

FIG. 5. IMPACT-TEST DIAGRAM.

(3) Curves corresponding to a slightly brittle metal the tensile strength of which is 95 kilograms and the elongation 10 per cent. (Figs. 5 and 6.)

The area of these curves gives the work if the apparatus has been calibrated for that purpose.

We recorded the time by the following method: A luminous point formed by the intersection of an epicycloidal slot in a disk turning before a fixed slot made an impression on the photographic plate carried by the hammer. In reality there

FIG. 6. IMPACT-TEST DIAGRAM.

were twelve slots in the disk (Fig. 2). When this disk revolved uniformly the luminous point seemed to travel uniformly along the fixed slot and traced lines, the inclination of which was proportional to the speed of the fall of the hammer. To get a complete curve for the fall these lines may be moved along and joined together.

The diagrams obtained with this impact testing apparatus fall, as we have seen, into three classes.

Curves characterizing non-brittle metals slightly ascend (Fig. 7), those of soft brittle metals descend (Fig. 8), while those of hard brittle metals are pointed (or sharp).

A comparison of the curves in Figs. 7 and 8 is particularly interesting when treating the problem in its entirety from a mechanical viewpoint and deducing from these tracings the amount of resistance offered by the test piece at each instant, while eliminating the spring vibrations.

The results at which we have arrived, but which refer only to the metals investigated, are now to be stated with great reserve as follows:

For the same metal the value of the initial ordinate seems independent of the breadth of the notch and the hight of the fall.

Here are the figures obtained from four different metals:

	Result Deduced from Tests.		
	By impact Resistance.	By slow traction. Resist'ce.	Elongat'n.
Metal F (Fig. 7)..	37 kg.	39	32 p. c.
Metal FF (Fig. 8).	40 "	39	39 "
Metal N.....	55 "	52	26 "
Metal DN.....	93 "	95	10 "

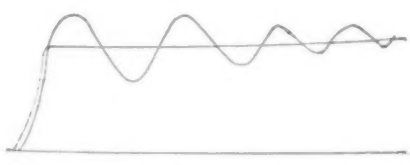


FIG. 7.

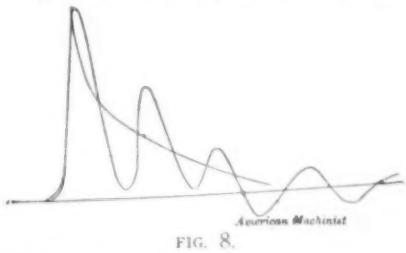


FIG. 8.

IMPACT CURVES OF TOUGH AND BRITTLE STEELS.

With the impact method the curves given are different for two metals comparable from a static, but discordant from a dynamic viewpoint.

The prospects of a good time coming for the British iron and steel trades, as a result of labor troubles on the European Continent, are becoming brighter.—*Mechanical World*, London. We would prefer to see our good time coming from some other cause. We do not believe either that, in the long run, troubles in one part of the world are good for the people that live in other parts. When we can't help each other we should at least be able to hope for each other.

"The man who is worthy of being a leader of men will never complain of the stupidity of his helpers, of the ingratitude of mankind nor of the inappreciation of the public. These things are all a part of the great game of life, and to meet them and not go down before them in discouragement and defeat is the final proof of power." And this from Elbert Hubbard, the man who wrote "The Message to Garcia."

Key Design.

BY ROBERT S. RILEY.*

The accepted rules and tables for proportioning keys in shafts are all more or less empirical. Why should not the dimensions of a key receive individual consideration just as much as any other element in a well-designed machine? It does not seem reasonable that intelligent designers should base their key dimensions solely on a table for shafts without considering the torsion which the key is to transmit.

There are other features besides the diameter of the shaft which affect the dimensions of the key required:

1. The shaft may be of large diameter to withstand a bending moment in addition to the torsion, and if so the empirical rule probably calls for a key far in excess of that required to transmit the torsion. All we need the key for is torsion, and any additional strength over that required for torsion not only detracts from the useful strength of the shaft, but is also more expensive to make.

2. The empirical rules fix the cross-section of the key without reference to its length. It would be just as sensible to design a gear tooth without considering the width of the face.

3. The torsional strength required of the key may be definitely fixed by some other element in the machine. Thus, for example, it might be the strength of a gear tooth elsewhere in the system which fixes the limit of strength useful in the key.

As a matter of fact, it will be only occasionally the case that the shaft has anything to do with the strength required of the key. And if the shaft does fix the limit it will generally be found necessary to use two or more keys to equal the torsional strength of the shaft. So here again the shaft diameter is misleading.

There is just one respect in which the diameter of the shaft is useful, and that is in determining a convenient and practical size of key for fitting. By following calculations we might fix the key dimension at some impracticable size, either too small to be fitted properly or too large to distribute the stresses evenly with ordinary fitting. In the latter case two or more keys must be resorted to, as determined by practical considerations. In all

*New York Shipbuilding Company, Camden, N. J.

cases the first thing to do is to calculate the dimensions required and then modify these as may be deemed advisable. This is the rational method of procedure in all scientific designing.

NEGLECT OF THE CRUSHING STRENGTH.

Another inconsistent thing we find among designers is that even when they do consider the stress on the key they are very apt to calculate only the shearing stress and to pay little or no attention to the crushing stress. As a matter of fact, it will be found on consideration of the usual forms of keys that the crushing strength of the key or of the sides of the keyseat is the limiting factor, and not the shearing strength of the key. One could almost see without resorting to figures at all that in wide, flat keys the pressure on the narrow sides of the keyseats and key must inevitably reach the limit of crushing strength before the key itself could be sheared. In other words, the key or keyseats will crumble and crush at the sides, whereas it is generally supposed that failure is due to the key being sheared thru.

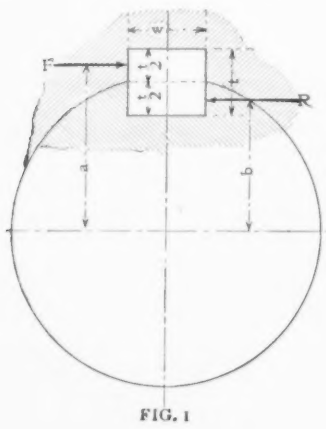


FIG. 1

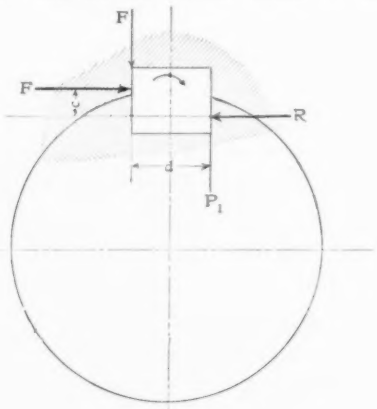


FIG. 2

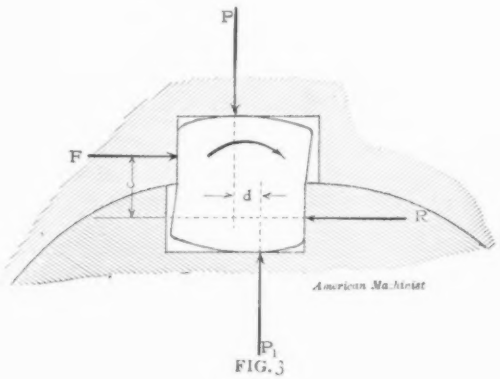


FIG. 3

THE DESIGN OF KEYS.

In Fig. 1 assume the driving force on the key to be concentrated at F in the middle of the keyseat. The resisting force R is likewise assumed to be concentrated at the middle of the side of the keyseat in the shaft. The arms about which these forces act are respectively a and b. Then the moment of resistance or torque offered by the key is $F \times a$ or $R \times b$. R is naturally greater than F owing to the arm b being shorter than the arm a, but it does not always follow that the force R is more destructive to the sides of its keyseat, for the material in the shaft is generally better able to withstand the pressure than is the metal in the hub. In order, however, to investigate the severest crushing stress we will consider the pressure R on the side of the keyway in the shaft. Then the moment of the key about the center due to the crushing pressure is $R \times b$, and this must be equal to the maximum moment M, which it is required to transmit by means of the key. The value of M will of course be determined by some other feature in the design, such, for instance, as the strength of a gear tooth or some other shaft in the system. Then $R \times b = M$, and $R = \frac{M}{b}$. But R represents the total pressure on the side of the keyway, and this is equal to the area multiplied by the pressure per unit of area. Let S_c represent the crushing pressure per square inch, l the length of the key, and $\frac{t}{2}$ the depth of the keyseat. Then

$$R = S_c \times l \times \frac{t}{2}$$

Hence $S_c \times l \times \frac{t}{2} = \frac{M}{b}$ and $S_c = \frac{2M}{b\,l\,t}$

But b = the radius of the shaft minus $\frac{t}{4}$

$$\text{Therefore } S_c = \frac{2M}{l\,t\left(r - \frac{t}{4}\right)} \qquad (A)$$

This is a formula from which we may determine the crushing stress in the side of any shaft keyway.

The shearing stress S_s is determined rather more simply by making M equal to the product of the radius of the shaft multiplied by the shearing stress over the area exposed to shear, that is

$$M = T \times S_s \times l \times b.$$

Hence

$$S_s = \frac{M}{b\,l\,T} \qquad (B)$$

These two formulas enable us to see at once the stresses to which keys are subject, once it is known what is the moment required to be transmitted by the key.

IMPORTANCE OF THE CRUSHING STRESS.

It is generally assumed (see Unwin, page 170) that the crushing stress per square inch allowed in keys may be twice that allowed for shearing stress. This would result in an approximately square key, with equal depth of keyseat in shaft and hub. For practical reasons in fitting, however, the width of the key is often made greater than its depth. This still further decreases the shearing stress per square inch relative to the crushing stress. Hence it is the more essential that the calculation should be made for crushing stress and not for shearing stress, as the latter, in practise, takes care of itself. The old fashion of using shallow keys and that of no keyway in the shaft at all except a flattened chord is proven to be absolutely wrong. It brings too great a crushing stress on the key and a change in form of the latter may easily set up a bursting strain in the hub.

These stresses set up in the hub or other containing body by the action of the key, form another subject that does not receive the attention which it deserves. In fact, text-books and authorities on the subject seem to ignore the tendency of the key to burst the hub. Referring to Fig. 2, we will assume a key accurately fitted on all sides as it should be. It is not enough to fit a key at the sides only, for then the rolling effect of the forces F and R cause the key to tip so that the pressures concentrate at the corners of the keyseat and crushing occurs. An accurate fit top and bottom therefore is essential to hold the key in place, and we can investigate the forces required to do this.

We have the driving and resisting forces F and R concentrated as before at the center of their bearing against the side of the keyseats. A moment is thus set up about an arm c which tends to roll the key in the direction indicated. An accurate analysis of this moment would require the calculation of the pressure at F as well as at R, and each force would be multiplied by its distance from the neutral center of the key, which equals $\frac{C}{2}$, and the sum of these two moments would be the total amount tending to roll the key. But we will simply take the force R into the arm c, as it makes no material difference in the result and shows the principle involved equally well.

The force R, as in Fig. 1, we have taken to be equal to $\frac{M}{b}$ or $\frac{M}{r - \frac{t}{4}}$, and c is one-half the total depth of the key, or $\frac{t}{2}$. Hence the moment of R about F is $\frac{t}{2}$ multiplied by $\frac{M}{r - \frac{t}{4}} = \frac{t\,M}{2\left(r - \frac{t}{4}\right)}$. Now this

moment tending to rotate the key must be resisted by an equal one in the opposite direction, and this is provided by the top and bottom pressure on the key. We may assume that it is held from rotating by the forces P and P_1 acting at or near the outer corners of the key. If the pressures be very excessive they will crush the corners and concentrate nearer the center of the key, but for illustration we will assume that they act nearly at the corners, and hence the arm of their moment is practically equal to the width of the key. The resisting moment is therefore the force P multiplied by the arm d. Hence the moment $P\,d$ must be equal to the moment $\frac{t\,M}{2\left(r-\frac{t}{4}\right)}$ and $P=\frac{t\,M}{2\,d\left(r-\frac{t}{4}\right)}$.

Thus it is evident that in any key we have a considerable tendency to split the hub, and this, too, under the assumption that the key is perfectly fitted, top, bottom and sides. Usually the strength of the hub to resist this action is so great that it need not be considered. In the case of a split hub or pulley, however, it should be taken into account in the calculation of stress on bolts. In the case of a split sleeve for a shaft coupling it also becomes a factor of great importance. In the case of a badly fitted key there is almost no limit to the stress that may be set up tending to split the hub. Even a solid hub backed by a strong gear wheel casting, with solid disk, may be burst by the action of a key that is not properly fitted. So many cases of this kind have occurred that it should impress upon designers the possibility of trouble and upon shop men the absolute necessity of fitting a key properly.

A SERIOUS BREAK-DOWN DUE TO NEGLECT OF THE ABOVE CONSIDERATIONS.

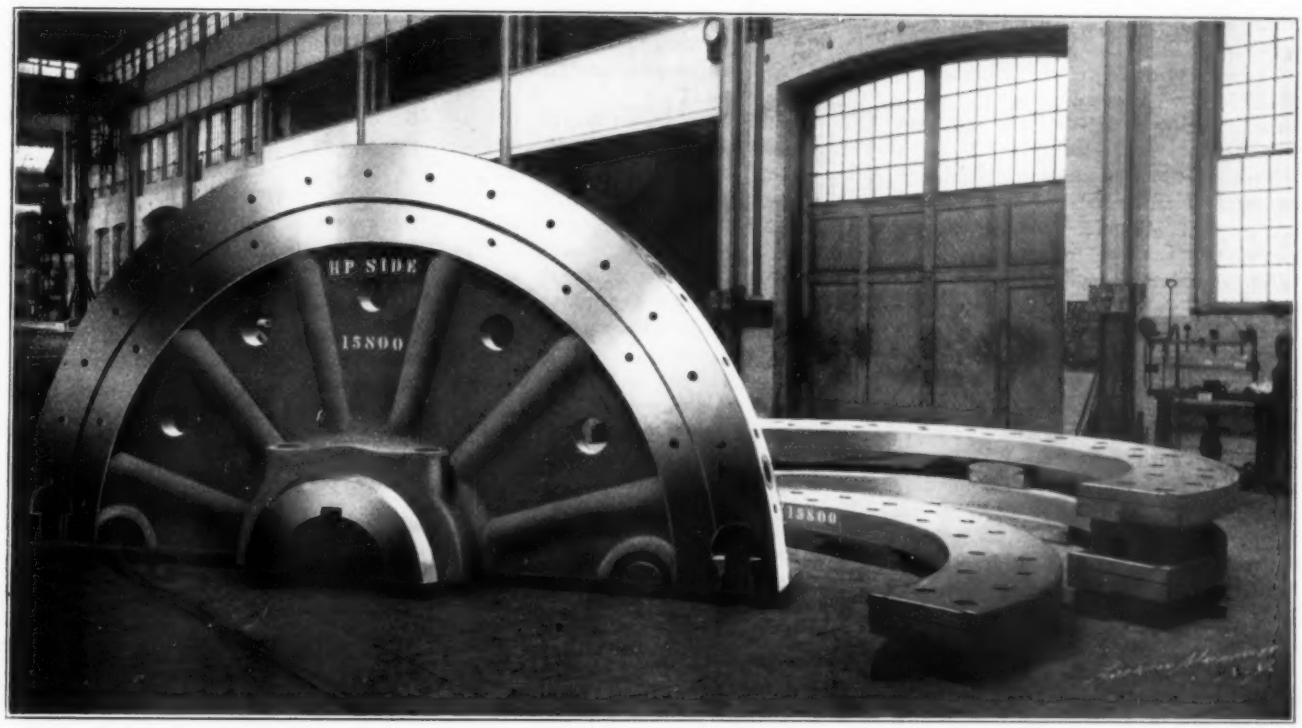
In Fig. 3 is illustrated a case where a very serious break-down was due entirely to the neglect of this important factor of machine design and construction. The key was designed, in the first place, so that if the gearing teeth were taken as the limiting factor, the pressure on the key and the sides of the keyway figured out to over 150,000 pounds per square inch. The shearing area was ample, but that, of course, was useless when the crushing forces were in such excess of the strength of the material. In service the pressures on the key and keyway caused them both to be crushed and distorted. The conditions involved a frequent reversal of forces, and this further augmented the trouble by developing lost motion and consequent impact at each reversal. The key had evidently been badly fitted in the shops. It was fitted very tightly top and bottom, but too slack at the sides. The result was that it finally rolled back and forth with each reversal, the corners becoming rounded over, as shown. The heavy gear at last split open, due to the abnormal pressure of the key. It showed a sound piece of gray iron with the fracture plainly begun at the hub and running out on a diameter perpendicular to the line of action of the key. A glance at the diagram, Fig. 3, will show plainly how this force became so great. We have the moment as in Fig. 2 of the forces F and R about the arm c. This moment amounted to 68,500 inch-pounds. It was resisted by the moment of the forces P and P_1 about the arm d, but the rounded surface of the key on the top and bottom brings the forces P and P_1 so far in from the corners that the arm d has become very short, say ⅛ inch in the case of a key 1 inch wide. Hence $P = 68{,}500 \div ⅛ = 548{,}000$, or over 270 tons tending to split the hub.

From this it will be seen how important it is that the design of keys should receive more than a simple calculation for shearing stress. It is the crushing stress that invariably causes failure, both of the key and the keyways, and even of the hub itself, no matter how strong the latter may be.

Heavy Flywheel Construction.

EDITORIAL CORRESPONDENCE.

The accompanying illustration shows a flywheel construction for severe duty which was recently used by the Nordberg Manufacturing Company, of Milwaukee, Wis. The wheel is of 16 feet diameter, weighs 120,000 pounds, and was designed for a speed of 125 revolutions per minute, the periferal speed being 6,250 feet per minute.



CONSTRUCTION OF A HEAVY FLYWHEEL.

The main body of the wheel is in halves, of gray iron, and cast with a solid web, as shown, the rim being reinforced by steel slabs bolted on in the manner which is now common. The novelty of the construction lies in the reinforcing bolts which pass thru bosses in the central web and have nuts at both ends. The object of these bolts is to furnish sufficient strength even tho the web should be seriously weakened by shrinkage strains.

F. A. H.

The Ball Expansion Drive Stud.

EDITORIAL CORRESPONDENCE.

The stud shown herewith is a distinct novelty in holding devices which has been developed by the Link Belt Engineering Company, of Nicetown, Philadelphia. The primary object in its development was to secure the flanges to the sprockets used in connection with the Renold silent chain. For this purpose long rivets passing entirely thru the sprocket, screwed stud rivets and driven rivets expanded by driving into a recess made at the bottom of the holes by a wabble drill had been tried without satisfactory results when the present stud was invented, and, after thorough tests and a trial of over a year's duration, has been adopted as entirely satisfactory.

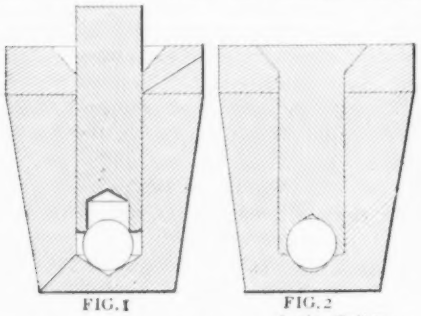


FIG. 1 FIG. 2

American Machinist

STUD BEFORE AND AFTER DRIVING.

Figs. 1 and 2 show the scheme complete, Fig. 1 showing a stud before driving, and Fig. 2 after driving and riveting over. In Fig. 1 the lower end of the stud is seen to be drilled to a diameter slightly less than that of a hardened steel ball which is dropped in the hole ahead of it. A few blows on the stud drive it over the ball and expand it into the surrounding metal when the head is riveted over, and the operation is complete. The lower end of the stud will be seen to be slightly chamfered to assist in closing it around the ball—an action which sections, reproduced in Fig. 6, of parts into which the studs have been driven, show to actually take place.

Very complete tests have been made both to determine the best diameter and depth of the hole and the holding power of studs of the best proportions, and extracts from the report of these tests are given herewith. In order to insure uniformity of conditions, a drop hammer was rigged up, with which the studs were driven, and they were then pulled out with a testing machine. In connection with the main tests the effect of a varying number of blows was also determined. The results of these tests are embodied in a thesis by H. T. Moore, of the University of Pennsylvania, to which I am indebted for the accompanying data and diagrams. In most of the tests it was found that the studs would start on the application of a certain pull, but that the resistance thereafter increased considerably to a maximum, and in the diagrams the full lines indicate the yielding, while the dotted lines indicate the maximum stresses. The figures at the summits of the lines give the stresses in pounds, the figures with *c b* annexed give the diameters of the counterbore in the stud, and the entries *b l* indicate that the bolts so noted were loose. In some cases the smaller studs broke without withdrawing, a condition which is indicated by the entry *br'k'g* annexed to the figure for the stress.

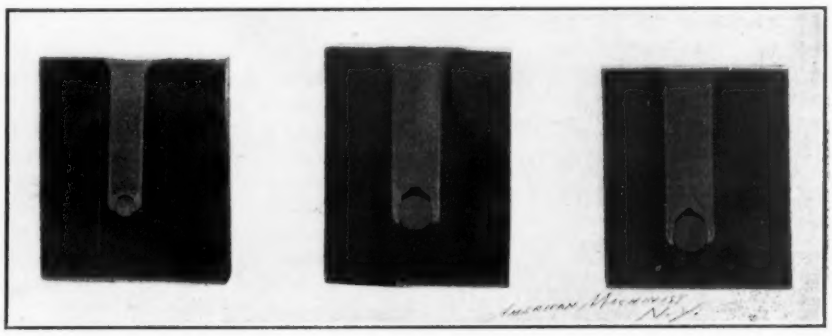


FIG. 6. SECTIONS OF STUDS AFTER DRIVING.

These tests indicate that the diameter of the counterbore should be about three-quarters of that of the stud; that the diameter of the ball should exceed that of this hole by about 1-32 inch; that the depth of the counterbore should equal the diameter of the ball, and that excessive driving weakens the hold. Further tests which are not yet completed indicate that the proper depth of the hole in the surrounding casting should be about twice the diameter for small sizes and one and a half times for larger ones. Depth beyond these proportions does not increase the strength, while shallower holes diminish it.

Of absolute results it was shown that 3-16 and ¼ inch studs are about 22 per cent. stronger than bolts of the same diameter, while the average grip of ⅜-inch studs is nearly equal to the breaking strength of the same size of bolt. The diagrams in which the results of the tests are plotted are self-explanatory, but it should be remarked that the comparatively low results from ⅝- and ¾-inch studs shown in Fig. 4 are due to the fact that in this series of tests the balls were only 1-64 inch larger than the counterbore, this difference being adopted to diminish the usual number of hammer blows, and at the same time insure proper driving. Fig. 6 has been engraved direct from three specimens, which, after driving, have been cut in half—the surface being then etched in order to bring out the different materials by contrast. The distinct closing

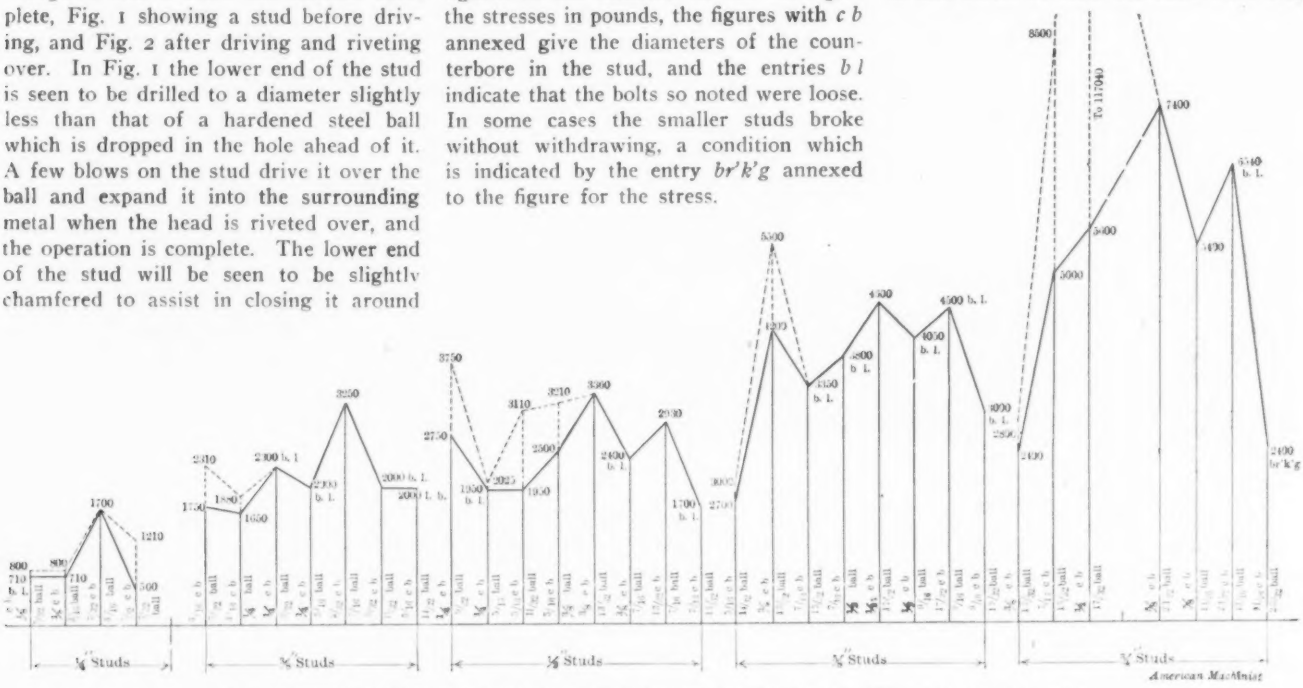


FIG. 3. PRESSURE CURVES OF STUDS WITH VARYING DIAMETERS OF BALL AND COUNTERBORE.

of the studs around the balls will be noticed.

There is obviously a large field of usefulness for these studs. They are, of course, inadmissible for securing steam chest and cylinder covers, but for a great variety of purposes, of which one is the securing of name plates to machines, they offer an obviously cheap and simple device. They will shortly be made an article of commerce by the Link Belt Engineering Company. F. A. H.

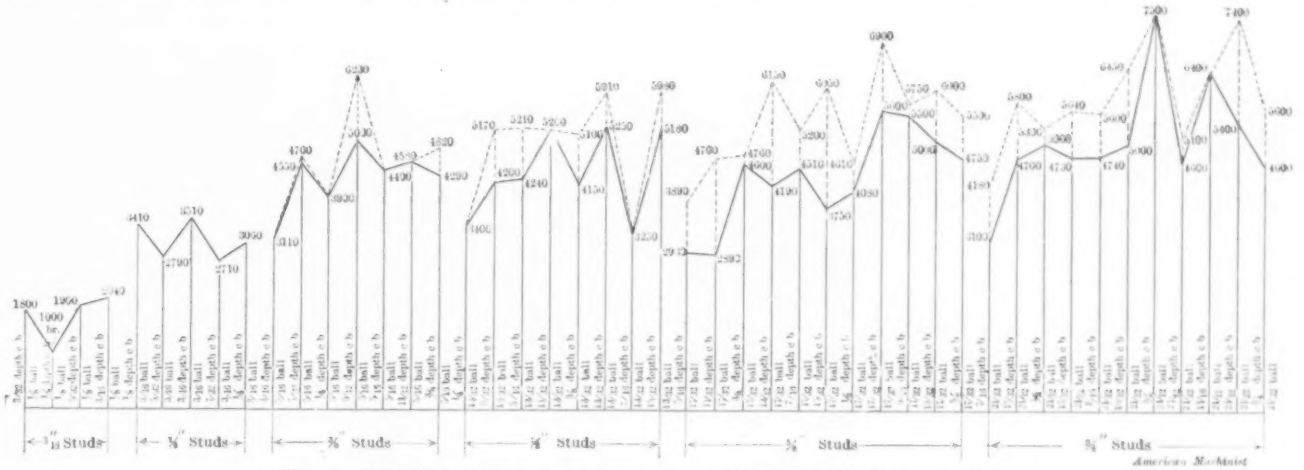


FIG. 4. PRESSURE CURVES OF STUDS WITH VARYING DEPTH OF COUNTERBORE.

In a paper recently published in the *Revue Technique*, M. L. Levi makes the following comparison between the calorific values of different fuels used in internal combustion engines. British thermal units per pound: Methylated alcohol, 10,620; methylated alcohol mixed with 50 per cent. gasoline, 14,200; crude American oil, 19,630; refined American oil, 19,880. The mixture of methylated alcohol can, it is stated, be used as easily as ordinary gasoline, but with unmixed gasoline it is necessary to warm up the carburetter a little before starting, as the alcohol does not vaporize readily enough below a temperature of 68 degrees Fahr. As an alternative, gasoline may be used at the start, the alcohol being supplied later. No trouble is found with the admission valves in using alochol, and if at times there is a deposit of soot or tar, this arises generally from the use of a bad carburetter. The carburetter should be of a type which will deal out a measured quantity of the liquid at each suction stroke.

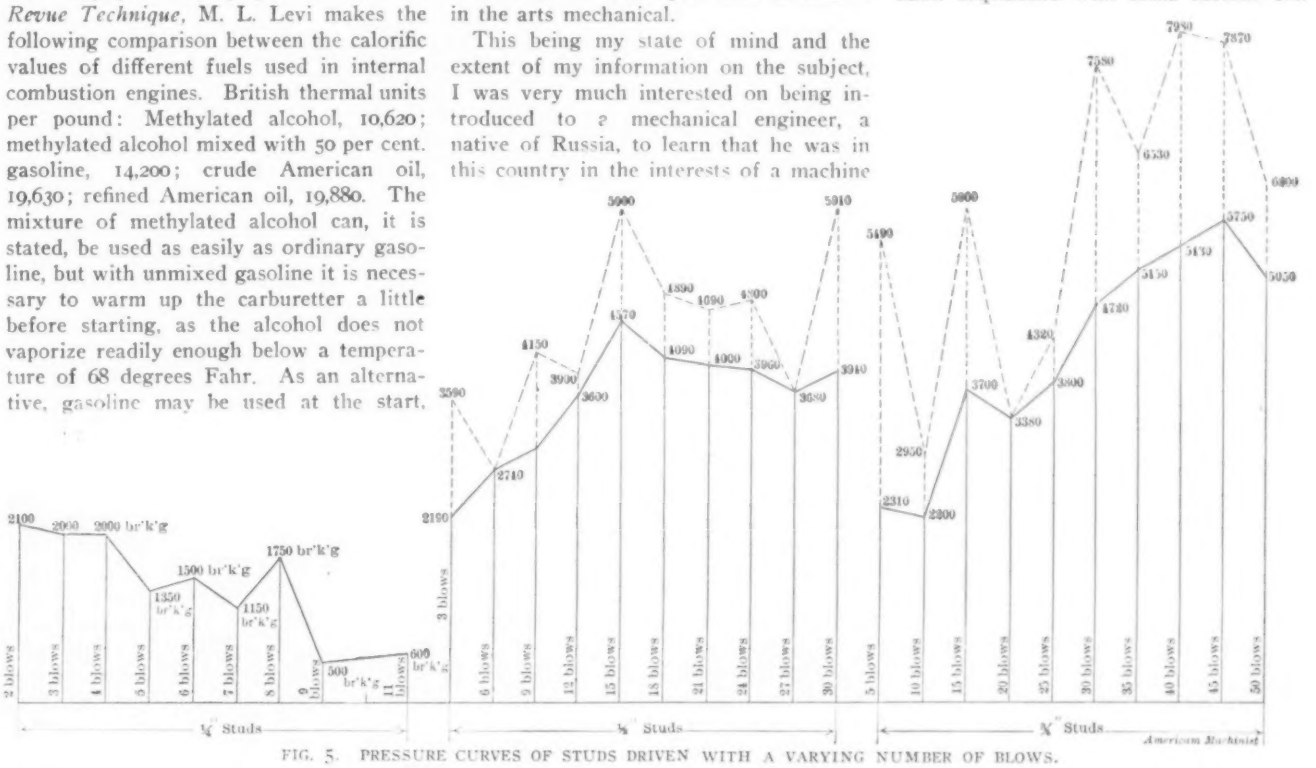


FIG. 5. PRESSURE CURVES OF STUDS DRIVEN WITH A VARYING NUMBER OF BLOWS.

An Ingenious Russian Machine in New York City.

BY W. OSBORNE.

Here in America we do not think of Russia as being the home of mechanics, nor of the Russians as a mechanically inclined people. While we do indeed read occasionally of their newly created machine shops, it is generally mentioned at the same time that Americans or other foreigners are in charge of the mechanical end of them, and thus it has come about that we look upon them as infants in the arts mechanical.

This being my state of mind and the extent of my information on the subject, I was very much interested on being introduced to a mechanical engineer, a native of Russia, to learn that he was in this country in the interests of a machine that was made in Russia, and which it was hoped would find a market in this country.

One machine had been sold in New York, and this gentleman, along with the proprietor of the works, who, by the way, was also the inventor and designer of the machine, was seeing to its proper installation and also looking over the field to see what the prospect might be for future business.

From the novelty of the idea that Russia could make machinery which could not only compete with this country on equal terms but pay the duty imposed and still compete, I was led to listen to what I could learn about this machine, and when I was given an opportunity of seeing the machine in operation I was very ready to take advantage of it.

In the course of the afternoon I became acquainted with some curious conditions, and one of them was that the people who had bought the machine were not at all friendly to visitors, who, for all they knew, might be interested in getting such a machine for their own use. If any more machines were sold in this country it would not be thru any recommendation from them. I was informed that it would

have been impossible for me to have seen the machine at all if it had not been for the presence of the makers of it. The reason for this state of affairs is that the product of this machine is sold, and it is sold in competition with hand work.

The amount that it is able to do is very great as compared with what a person can do by hand, and thus it is possible for the owners of the machine to undersell hand work enough to get all the business they can take care of and at the same time to have a large profit left. It would make more difference to them than it would in the business of making machine tools if one shop was equipped with modern drill presses, while all the others had to do all of their drilling by hand with ratchet and breast drills.

I am not going to tell you where to find this machine, and for one very good reason—I do not know myself. I am a stranger in the city of New York, and when I say that and then say that in company with another I left Broadway and blindly followed my guide over into the east side, where I had new sights and new sounds constantly so attracting my attention that if the guide had not been a very tall man, I would have been many times in danger of being lost; and when I tell you that even the guide had to occasionally stop and ask questions and alter his course, you will not be very much surprised to hear that I do not know where that machine is. It is somewhere in the space between the Williamsburg and the Brooklyn bridges, and between Broadway and the East river; possibly that will be sufficiently close to guide a native New Yorker. They seem to be able to get around equally well whether going underground, overhead or straight up and down.

This machine is for making cigarette tubes. It takes the material and delivers the tubes ready for the tobacco. Some of them are sold in this shape to the users of such things, and some are sold to factories that put in the tobacco and other abominations that go to make up the finished product.

The tubes are made from a rice paper that is about .0013 inch in thickness and a little over 1 inch in width. The machine takes this paper and prints on it at proper intervals the designs and letters required. There is a complete little printing press arranged for this as a part of the machine, and also an additional arrangement whereby a design in gilt can be put on. As the strip of paper goes onward it is formed into a tube, the edges of it making a lock joint like that put into stove pipes, and a set of rollers flatten this joint down. Just as the flattening operation is completed, a pair of shears cuts the tube off. These are "flying" shears; they move back and forth and do the cutting on the forward movement when they are moving at the same speed as the tube. They work so nicely that they cut off this thin tube without flattening it, and that without the tube being supported on the inside. A mechanical hand is waiting for the detached tube, and as it closes on the tube the arm to which the hand is attached moves forward and stops in front of a hole which is the size of the outside of the tube. By a longitudinal movement the tube is slid into the hole for a short distance against some very delicate little fingers. These six little fingers immediately draw the edges of the tube outward against the sides of the hole, which is at this point very slightly enlarged, and a tube of heavier paper, .006 inch, is pushed inside of it. This inner tube is 1½ inches long. As it reaches its place so that it is even with the end of the tube held by the fingers, they release and a steel tube begins to push the double tubes out of the hole, and at the same time an internal roller, which an instant before had helped to form the internal tube, reverses its motion and causes it to expand so that it is a tight fit in the outer tube; it also removes all traces of the expanding caused by the fingers in holding the tube. As the tube leaves the hole it is taken by another hand which closes on it, and the arm to which the hand is attached swings it forward to another hole, and again it is slid in and held fast while a loose piece of cotton is delivered to the inner end of the internal tube. This cotton is to act as a strainer when the cigarette is in use. From this hole the tube is carried by a hand which delivers it on a table ready to be packed and shipped.

The inside tube is formed from a paper that is somewhat heavier than good writing paper. This paper is in a roll and is mounted above the machinery that handles it. As it passes along to where it is formed into a tube it has six punches passed thru it near one end. These punches cut out two sides of six triangular pieces and bend them at right angles to the paper. The paper is cut to the proper length so that when formed into the tube it will be double, and is seized and rolled into a tube with the little pieces that the punches had made projecting inward to form a stop for the cotton to be presently pushed in against them. As soon as the roll is formed it is pushed forward into the outside tube and expanded there.

Perhaps you do not see anything wonderful about this so far, as it may seem quite a while since that paper started into the machine, but this machine could throw out the finished tubes at the rate of 240 per minute, and with the machine running and doing its work the eye could gather very little information. It was only when the machine was turned slowly by hand that the operations could be followed, and many of the parts were so minute that even after they were taken from the machine and held in a good light to be seen, it needed careful explanation to be able to follow their construction.

As we were watching the machine it stopped of its own accord, and it was because the paper of which the tubes were made had been pasted together in the roll and formed two thicknesses at one point. This the machine called attention to by stopping. We were then shown that breaking either of the strips of paper produced the same result. Doubling the paper that formed the inner tube would also stop the machine. If the paper on either roll ran out, it would stop. It seemed to be so constructed that it must produce perfect work, and if the conditions were not right for that it would not run. This machine far surpassed what I had expected to see from the description which I had received in the quiet, unemotional English when I first heard of it, but I was further shown that it was thoroughly adjustable in every way. It would make long or short tubes. It would make large or small tubes. These changes must all be made easily, quickly and with certainty.

To test the accuracy of the timing of the operations, I examined numbers of the finished tubes. I found the printing all the same distance from the end. It will be readily understood that the slightest variation in the timing of the operation of printing and of cutting off the tubes would cause the printing to crawl one way or the other, but careful examination does not show any such tendency.

To show what the output of this machine means compared with what has gone before, I will say that near this machine was another one made by the same company. It made the outside tubes and cut them to length, and then the inside tubes were put in by hand by girls, one of whom told me that she could put in about 5,000 in a day. These inner tubes did not have the stops to keep out loose particles, neither did they have the bit of cotton that acted as a filter. The machine would do in an hour what it took three girls nearly a day to do, besides doing the work that the other older machine would do, and the output was better suited to its purpose than that which was partly done by hand.

Besides seeing the machine and examining its workings, and finding out that there were people who thought very well of a machine and yet would not do anything to help the sale of others of them, I got a slight insight into another side of the business. The output of such a machine is so great, and its natural life is so long, that no conceivable increase in the demand will be sufficient to call for the output of a large factory, and so the makers of the machine are on the lookout for some other line of machinery which will fill a need of the world.

Inquiry revealed that the factory in Russia employed a hundred men, and that these hundred men built fifty such machines in a hundred days. This would be about one hundred and fifty machines in a year, and figuring on each one being run for ten hours a day the output from them

would be enormous, and there is no reason that they cannot be run continuously if use could be found for their product. All men are not smokers, and all smokers do not use cigarettes. Even if everyone went to using them so as to use up the product of these machines the result would likely be such an increase in the death rate as to soon offset the temporary gain.

During the course of our conversation about these things it came out that neither the owner of the factory, who was present and who was the inventor of the machine, nor the mechanical engineer who was associated with him, and to whom I owed the privilege of seeing it, nor either of us who had gone to see it, made any use of its product or of tobacco in any form.

This machine would compare favorably in workmanship, skill of design and accuracy of operation with anything that I have ever seen made in this country. The business card I received on being introduced showed a curious combination, or at least so it seemed to me. It reads: "J. A. Semmenoff, Machine Factory and Sawmills. St. Petersburg, Pesochnaia, 6. K. Jouravleff, General Manager."

I know something about sawmills myself, but I can hardly think of them as being associated with a machine like the one I have been trying to describe.

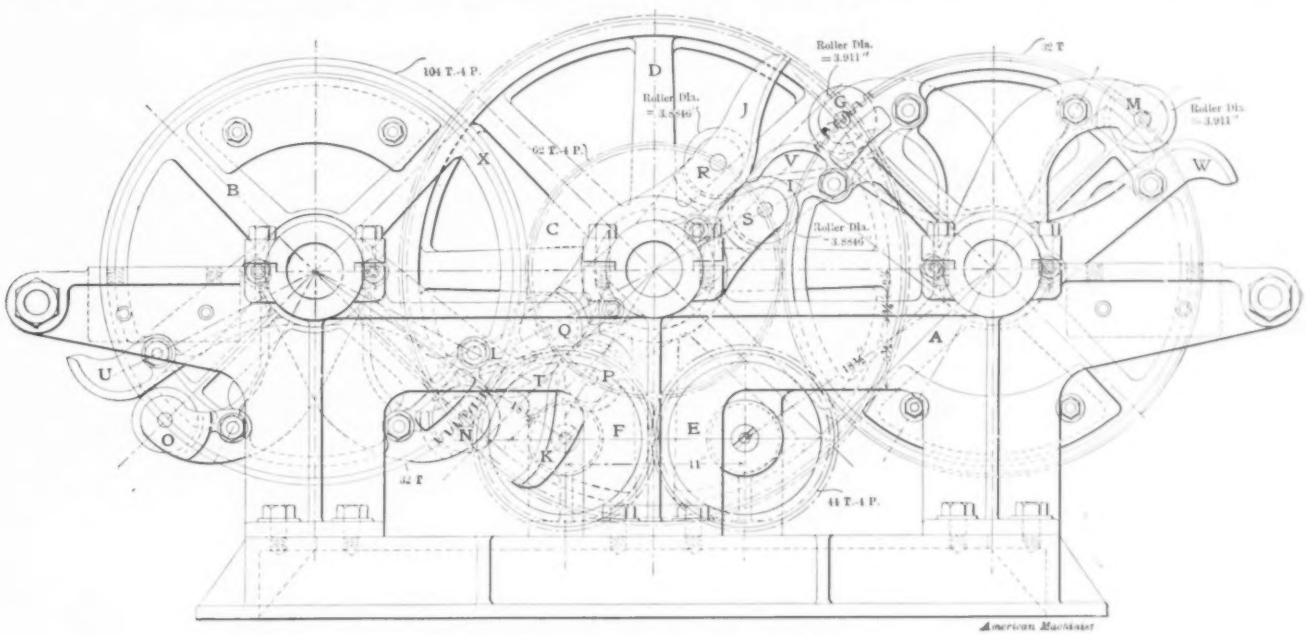
Ames College, Iowa, has recently received as an addition to its mechanical museum an old and peculiar locomotive. It has been used on contracting and construction work and has been owned by a number of railroads in succession. It is 3-foot gage, Forney type, with outside valve motion, and the cylinder on a truck separate from the boiler. It has the old-fashioned funnel stack, small drivers and tender and an enormous headlight.

A Mechanical Movement.

The line cut shows the application of a mechanical movement, for which Frank H. Lindner, of Bayonne, Hudson county, N. J., has lately been ganted a patent. The particular function which it here performs is actuating the reciprocating bed of a printing press.

The gears *A* and *B* are segmental, having but 32 teeth, the balance of their rims being made so as to clear the teeth on the gear *C*. *A* and *B* are mounted upon parallel shafts and are in the same plane as the spur gear *C*, with which they alternately engage. Upon the same shafts with *A* and *B* but on a different plane from that occupied by *A* and *B* are two spur gears traveling in opposite directions at the same rate of speed, being in mesh with the two idlers *F* and *E*. On the one side of the spur wheel *C* are the cams *J* and *K*, and upon the other side are the cams *L* and *I*. These cams come into engagement alternately with the rollers *G* and *M* on the segmental gear *A*, and the rollers *N* and *O* on the segmental gear *B*. The shape and position of these cams is such that at the instant the roller *N* releases the cam *L* the roller *G* engages the cam *I*, reversing the direction of motion of the gear *C*. As the roller *G* traverses the cam *I* it gradually increases the speed of the gear *C* till the teeth on the segment *A* are in engagement with the teeth on the spur gear *C*. It will be noted that the centers of all the rollers are the same distance from the shaft centers as are the pitch circles of the various gears to which they are secured. By the time the roller *M* is ready to release the cam *L* the cam *J* is in a position—approximately indicated by *X*—ready to engage the roller *O* and have the direction of its movement reversed. The rollers *P*, *Q*, *R* and *S*, secured to the same shaft as the gear *C*, engage the cams *T*, *W*, *V* and *U*, mounted on the segmental gears *A* and *B*. Upon the same shaft as *C* is a large gear *D* which engages with the rack upon the under side of the reciprocating bed of the printing press.

I saw this mechanism applied to a printing press bed the weight of which was ove 4,000 pounds, the travel about 6 feet, the number of strokes per minute 18. There was no noticeable shock at either end while reversing.



AN INGENIOUS MECHANICAL MOVEMENT.

A Technical Graduate as a Shop Apprentice Writes to a Chum.

Dear N——:

No! I haven't forgotten you at all. Just been working all the time, Saturday, Sunday and Monday nights, Tuesday, Wednesday and Thursday during the day. We work most of the time at least seven days in the week. My work consists of inspecting apparatus on the cars on a certain part of the line of the railway, and fixing up any trouble, not directing it, nor showing someone else how it should be done, but actually putting on overalls, climbing down into a pit under the cars and working like h——. My hands are in such horrible shape that I wouldn't think of dining in a respectable café. W—— and I are working together, he being my boss, in a car barn where, till to-day, everything except a part of the heating apparatus and some of the workmen were frozen. To-day it thawed a little, *i. e.*, inside the car barn. That's what we are up against. I'm not discouraged at all and I like my job and the prospects for advancement. By all means get into either alternating-current single-phase or multiple control railway work. When you learn anything learn it for keeps, and when you work in the shop actually do the work. That is the mistake that most men make. They think (I was as guilty as the rest)

that the object of the game is to learn how to do things by watching someone else do it. Get that out of your head as soon as possible. Don't try to learn how to show someone else how to do the thing. Learn to do it yourself by actually doing it. Chipping and filing are not very attractive things in themselves, but during the one week that I have been here I have kicked myself a hundred times because I didn't learn both when I had the opportunity. I made a fool out of myself not working all the time that I was in the shop and, if possible, I want to warn my friends from making the same mistake. You said that you wanted railway work and construction. I think your choice is very good. If you profit by my mistake and do as I suggest, work every minute and you will be the goods when you leave the apprenticeship course.

Also I want to advise you to go to see people—not play the society game and wear yourself out, but meet and learn to know all kinds of people. It will help a lot. Don't think that people in your own station in life are the only ones worth knowing. It is worth while to know all sorts and conditions of men, and not only to know them, but to be liked by them. Up to the present it has been almost against my principle to make use of hot air. From now on I intend to use it to a certain extent. Don't think it beneath you to jolly a foreman into getting anything you want out of him. If you get what you want, that fact means that you are making good just as much as doing anything else worth while and will count. Go to the Electric Club. A man can learn a lot there. It isn't very easy, but make yourself do it. The officials of the company are right in saying that there are opportunities in electricity. It looks tough to one to see good men trampled on in a certain way, but the company has enough apprentices to make it possible for the men who are both good men and energetic men to be given the preference.

Be the man they want. First, work with your own hands if you are in the shop, but let your brain work at the same time. Second, get all the information and good out of the course that you can by getting the foremen, everyone with whom you come in contact, to do what you want. Third, go to the Electric Club as much as possible. Fourth, meet and know people in Pittsburg. Show this to C—— and especially to S——, who is still in the early stage of the course.

Hoping to hear from you some time soon, I am as ever,

Sincerely, J——.

P. S.—This may seem a very unnecessary lot of advice, but I realize my own mistake and don't see any good reason why you should make the same one without an attempt on my part to stop you. I'll send that eight dollars when my back pay arrives from Pittsburg.—*Electric Club Journal.*

A Keyseat Locator for Eccentrics.*

An interesting and useful instrument has been recently introduced by Messrs. Baird & Tatlock, Limited, to provide a means for marking off accurately and quickly the positions of cams, eccentrics, etc., on shafts.

It does away entirely with the necessity for marking off templets, the cost of which is considerable, especially on shafts with three or more cranks. The locator consists of a frame *F* carrying a slide *S* which runs parallel to the faced edge *E* of frame. On the slide is a movable block *M* with a graduated scale *G* and a spirit level *L*.

The scale *G* is set out to indicate the angles between the known positions and those to be found, the circular arcs indicating valve travel and the horizontal lines the lap + lead.

A swinging piece *A*, which is pivoted on the moving block at the center of the graduated arcs on the scale, carries two pointers *P* and *p*, each arranged to slide parallel to one another. The small pointer *p* is used for reading off the graduated scale, while the large pointer *P* is marked off in divisions corresponding to the diameter of the shafts. The moving block *M* and the swinging piece *A* can each be fixed in any desired position by means of thumbscrews.

On the pivoted frame *B* are mounted two levels, *I* and *I i*, at right angles to each other, for use with the locator in a vertical position.

To find the positions of the eccentrics on a crankshaft, the latter is arranged with the crank-pin vertically underneath. The pointer *p* is set to the position on graduated scale which gives the required lap + lead of the valve and also its travel (see Fig. 1). The swinging piece *A* is tightened down in this position. The pointer *P* is fixed to the division number corresponding to the diameter of the shaft; the locator is then placed, as shown, against the latter, and after the locator is set horizontal by level *L* the sliding block *M* is moved along the frame, when the position on the shaft shown by the end of the pointer *P* will be the center of the key-bed for one eccentric.

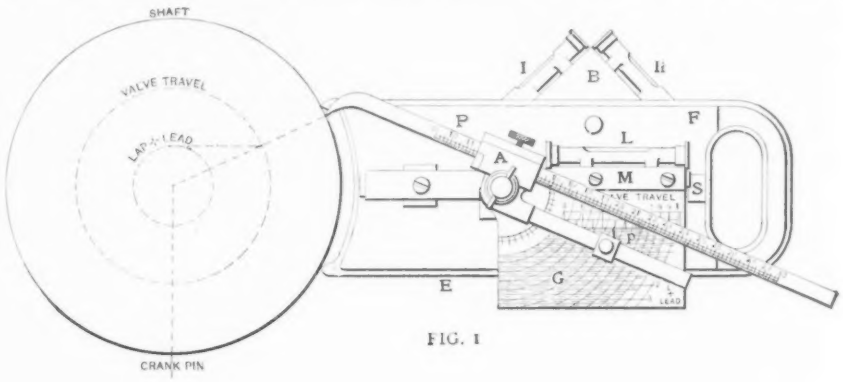


FIG. 1

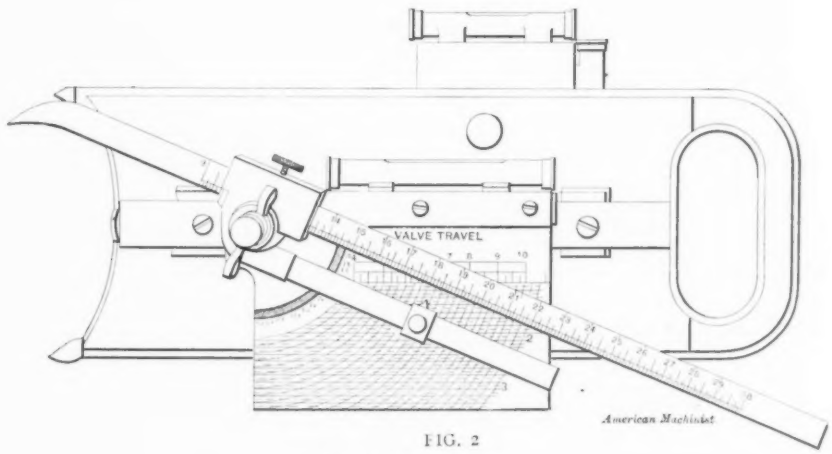


FIG. 2

KEYSEAT LOCATOR.

On applying the locator to the opposite side of the shaft, and proceeding in the same manner, the position of the other eccentric may be marked off.

In the event of the crank-pin not being directly vertical under the shaft, the bottom face *E* of the frame is applied to the web of the crank, then the small level *I* is set horizontal and the frame *B* fixed in this position. If then the locator be moved round the shaft as before till the level *I i* is horizontal, the pointer *P* will again show the position of the eccentric.

In all cases the correct lead to add to the lap is the mean value of the leads at either end of the cylinder.

By way of example, suppose a 12-inch

*From *The Practical Engineer.*

shaft on which the position of eccentric has to be found for a valve travel of 8 inches, and where lap + lead is 2½ inches. After arranging the shaft with crank-pin vertically underneath, the pointer *P* is set to the division indicating 12 inches, the diameter of the shaft.

The swinging piece *A* is fixed so that the pointer *p* is at the junction of the 8-inch valve travel line and the 2½-inch lap + lead line on graduated scale; then the sliding block *M* is moved along the slide after the frame of the locator is set horizontal against the shaft. The position given by the pointer *p* on the shaft will be the required center of keyway for the eccentric.

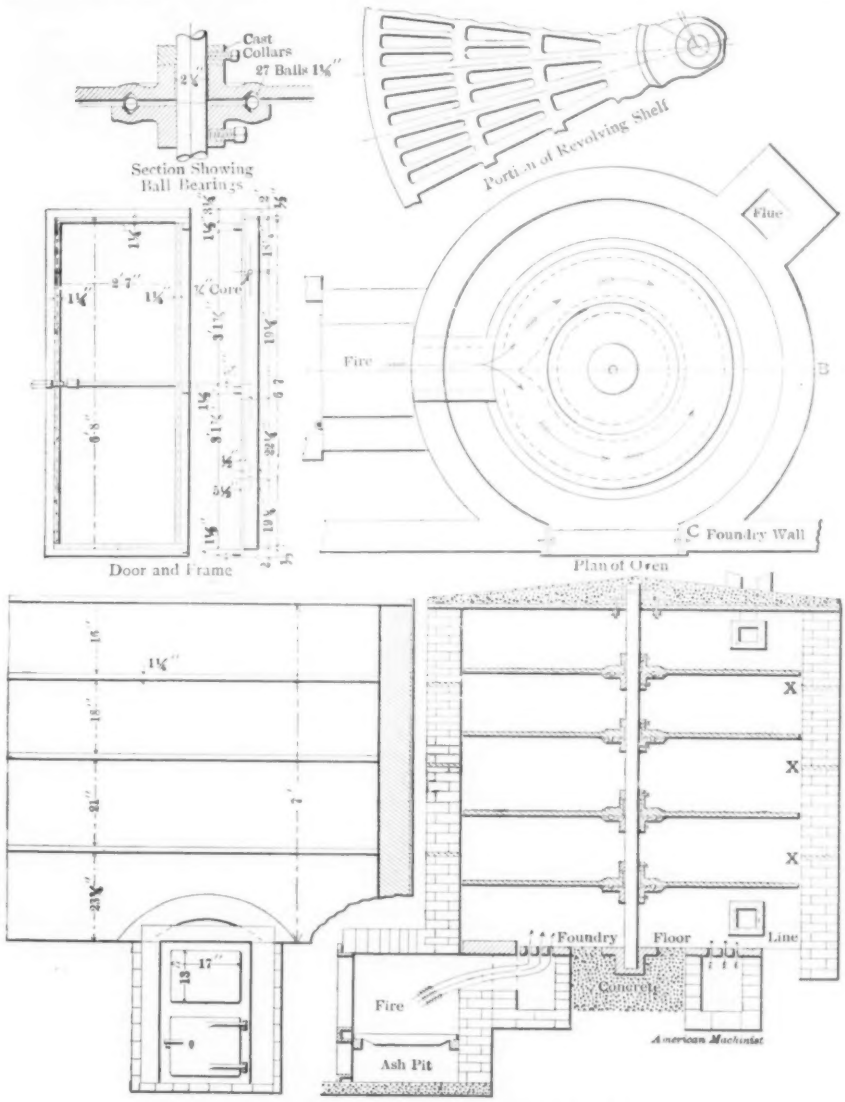
In the event of the position to be found being less than 90 degrees from the crank-pin, the latter must be set vertically over the shaft; in all other cases it must be vertically under.

The locator may also be used for marking off positions when only the angle of advance is given. In this case use the arc divided in degrees on the scale, placing the pointer *p* at the required angle (see Fig. 2), and proceed as before.

Letters to the Editor.

A Core Oven With Ball-Bearing Shelves.

Having noticed a rotary core oven at page 58, it occurs to me to show the readers of the AMERICAN MACHINIST an oven which I have recently designed and which is in most satisfactory use. It is designed for the rapid drying and handling of small and medium sized cores. We were drying our small cores in a large oven, which was at the least very unsatisfactory in a shop where many small cores were used, and the hurry job had usually to wait until its hurry was over. The oven we built was 7 feet in diameter and 7 feet high, with four independently rotating shelves. The drawings given are the actual working drawings, and being all to the same scale, except the two upper views showing details, any dimensions may be easily determined. In the vertical section of the oven the plates *X* are building plates about ¾ inch thick, cast in open sand and secured to the upright door frame, as shown at C in the plan. The tricks of the loam molder are here employed to advantage as, so strengthened and sustained, the oven cannot possibly crack or sag in any direction. The oven is built outside the foundry building, with the door opening into a convenient part of the core shop. The shelves were each cast in one piece and set in before the top plate was put on. There are two openings connecting with the main flue for the proper regulation of the heat, with slides operated by levers, not shown, at the side of the oven door in the core shop. The underground fire has the advantage of distributing the heat evenly throughout the whole oven, so that there is no hot spot and, with ordinary care, no chance of burning the cores. The rotating shelf has a great advantage over the stationary one. In the latter the workman has to lose much time in placing his work, his arms being exposed to the great heat all the time, while with the former the desired piece is brought to the door at once, and in putting in work the same advantage is found. JAMES A. MURPHY.



CORE OVEN WITH BALL-BEARING SHELVES.

Locating the Decimal Point With the Slide Rule.

The rules for locating the decimal point when working with the slide rule are a bugaboo chiefly to the beginner, and I have known persons to begin the use of the slide rule and then cast it aside solely on account of the difficulty of being sure that the right rule was used in the right place. While this would seem unwarranted, there is undoubtedly an advantage in having these rules as few and simple as possible, not only for the beginner, but for the habitual user as well. True, after one becomes accustomed to using a rule he can use it about as easily as any other, but there is no use in burdening our minds with more than is necessary.

A rule that I use and which is easily remembered, not entailing the committing of formulas to mind is as follows:

By digits in the following is meant the number of figures to the left of the decimal point in a whole or mixed number, and the number of ciphers to the right of the decimal point in a number wholly decimal, the value of the digits in the latter case being negative or having a minus sign, *e. g.*, 48 and 34.75 each have two digits, 3.475 has one digit, .3475 has no digits, and .03475 has one digit whose sign is minus.

In multiplying two numbers, if the slide projects from the left-hand end of the rule, the number of digits in the product equals the sum of the digits in the multiplicand and multiplier.

If the slide projects from the right-hand end of the rule, the number of digits in the product equals the sum of the digits in the multiplicand and multiplier, minus one.

In dividing two numbers, if the slide projects from the left-hand end, the number of digits in the quotient equals the

number in the dividend minus the number in the divisor.*

If the slide projects from the right-hand end, the number of digits in the quotient equals the number in the dividend minus the number in the divisor, plus one.* This rule is not original with me, but so far as I have been able to learn, it is in less general use than some others which are more complex.

When finding the continued product or division of several numbers, the rule has of course to be applied to the first two numbers taken, then to this result and the third number, and so on, applying the necessary rule each time the position of the slide is changed, so that when all the operations indicated have been performed, and the figures of the result are known, the position of the decimal point is known at the same time. ALAN BENNETT.

Pattern for a Window Jamb.

Fig. 1 is a sectional view of a large window jamb 14 feet long for a power-house. One of the particular points about the job was that it had to be very smooth at *A* in Fig. 2; for that reason we were unable to put a core as in ordinary use. Fig. 3 is a strip of maple about 15 feet long—long enough to go thru the end of the flask. This strip is put on the pattern with draw nails as shown. After the nowel is rammed up, the maple strip is pulled thru the end of the flask, as at Fig. 5, which leaves a very clean mold. Fig. 5 also shows a section of the pattern with the bed board in place. After the nowel is rolled over, the bed board is taken out and thickness strips are placed in running the full length of the pattern, see Fig. 6. These strips can be hung on the edge of the pattern with bent nails, as shown in Fig. 6. When the cope part of the pattern is fully rammed up to the edge three tie pieces, Fig. 4, are placed in. They have plenty of taper, so that they can be pulled thru the cope easily.

By making this jamb as explained we got a very clean face on top and with the thickness strips and tie pieces the casting was made straight and the sides were kept from spreading. JOHN F. PITZ.

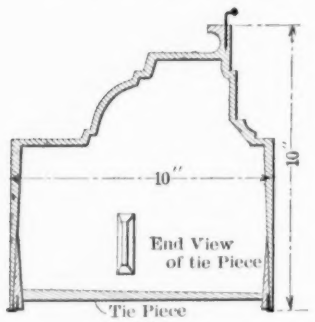


FIG 1

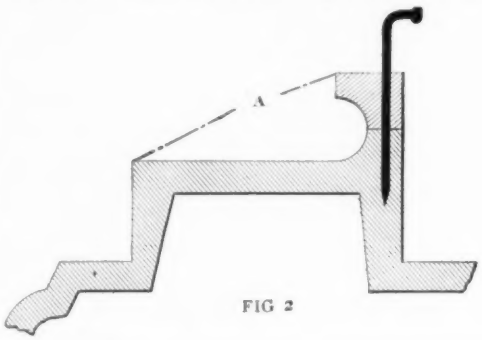


FIG 2

FIG 3

FIG 4

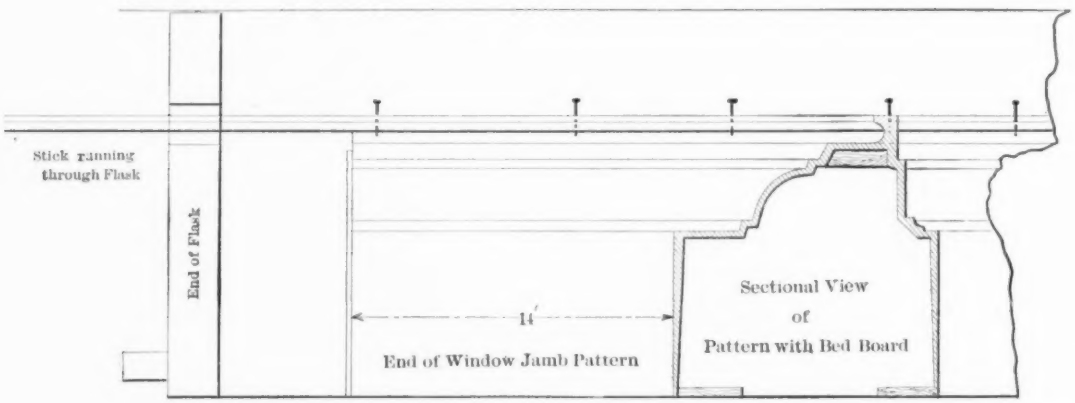


FIG 5

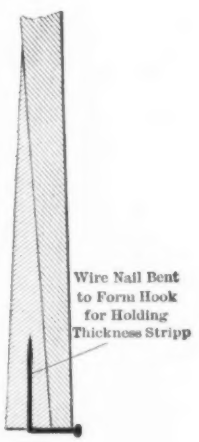


FIG 6

PATTERN FOR A WINDOW JAMB.

The Man Who Hustled.

Please don't ask me to locate this story.

He was the leading hand, but another firm offered him a job as foreman, so he left. In his new position he felt very important and determined that his department should outshine every other department like a searchlight to an oil torch, so he hustled. He made three circuits of his department every twenty minutes, and each time made all the hands understand that they were not turning out as much work as was expected. His best men—the high-grade workmen—all looked out for new jobs, and one by one they quit, but as he had discovered he could get cheaper labor to fill their places he was more pleased than sorry. The $1.75 men always managed to be extremely busy when he came round, and as just working wasn't enough they took great care to be moving very rapidly, as in rapid chipping, high-speed filing, or even rushing across the floor, and sometimes when a man was chipping with extra vigor—perhaps on a piece of scrap iron—the foreman even looked pleasant for a moment.

No man ever received any encouragement or was told that he made a good job of anything, because the foreman thought it a mistake to let a man think he was doing things right; it might give him a swelled head. So every man was kept under the impression that he might receive his notice on Saturday.

The $1.75, the $1.50—and there were some $1.00 men there now—were kept jumping and "hustling" till that department looked more like an insane ward than a manufacturing department, and when the superintendent came round the foreman made eight circuits in the twenty minutes and boosted up the excitement a good 60 per cent.

Things went on this way for about six months; then the superintendent sent for William (the foreman). William made an extra dash, so as to get a little out of breath, and then went to the superintendent's office with the pleasant anticipation of an increase in wages for exceptional results. Poor William!

The superintendent carefully and definitely explained that William's department was turning out an article much inferior to that produced six months ago; customers were dissatisfied; orders were being cancelled, and the cost of production had gone up. William must improve, and he was to understand that he was on his last trial.

*The writer assumes that the lower scales are used in all cases and that in division the dividend is read on the stock.—Ed.

To say William was astonished is putting it mildly. He couldn't understand; there must be a mistake somewhere. Why! no other department hustled like his. Anyhow, he went back and raised Cain. "Any man who didn't double his output in one week would be fired; they had been having too easy a time and had taken advantage of it, but he would show them." The two best men in the department would not stand for a calling down like this, so they quit. Then William took off his coat and hustled in their places.

With a magnificent effort he managed to do their work and also to make a flying dash round the department every now and then. He was the first there in the morning and he worked till late every night. It would be no exaggeration to say he did the work of three men. But, strange to say, the superintendent was not impressed by the activity of William, nor his long hours. The superintendent had a way of always judging a man by results, and results only; so activity and jump did not count. He even went so far as to say that if William would only come down in a white shirt, use his brains and see that the men did the work, instead of trying to

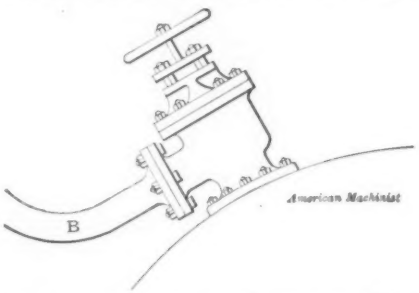


FIG. 1. WHERE THE WATER WAS TRAPPED.

do it all himself, then things would certainly improve.

But Bill kept on. He gave all his men a good "jacking up" every morning to make them understand they were to get out more work and not waste any time, and he also told them there would probably be some changes on Saturday. Then the department would start in with the usual excitement.

The cost-keeper figured costs and reported twice a week that Bill's department was still high—very high. The shipping clerk reported every day that more and more of Bill's product was being returned as unsatisfactory, or not up to samples, and they got strong letters from customers, too.

The superintendent sent once more for Bill. Bill came hoping that this time he would be told that things were better. Again, he was doomed to disappointment. The superintendent said that things were about as bad as they could be, and that Bill had better get a job as boss of an excavating gang or something like that, where plenty of noise and excitement were necessary to keep men of that grade in working trim He explained the difference between keeping the men constantly working in a calm and contented manner and having dissatisfaction, uproar and excitement everywhere, and he told Bill about the great need of keeping the quality up and not passing small flaws in the vain hope of saving waste, because it would quickly ruin the firm. Then Bill left.

GEO. P. PEARCE.

Trouble Caused by Shore Machinists Thru Ignorance of Conditions at Sea.

In hiring machinists to work in the shipyard or drydock the foreman usually gives the preference to men with some seagoing experience, as much for his own benefit as the firm's. The man who has not had his whack of seagoing usually requires more looking after than his more experienced brother, as in his lack of knowledge he is liable to finish off a job in a manner which calls for its being overhauled at sea, much to the discomfort of the ship's engineers.

Some time ago I was on a ship in drydock for overhaul and repairs, and heard the foreman reprimanding a machinist for neglecting some detail on the job he was engaged on, winding up his remarks with the question, "How would you like to put to sea with a hashed-up job like that?"

Finding myself later in the vicinity of the work, I stepped over to have a look at the cause of the trouble, and found that the machinist had been fitting up a large feed suction valve on the hot-well. It was a valve with a 14-inch flange bolted to the well with thru bolts of ¾ inch diameter, and tho the job was practically finished in the machinist's opinion, not a single bolt had been grometed* round the neck. A sweet job we would have had, floundering around in the bilges putting on the gromets, if the leaking bolts had been overlooked till we were at sea.

Another case of mistaken judgment in valve arrangement gave us a little trouble till we had the fault remedied. I was engineer of a ship which had her battery of three double-ended boilers renewed. They were of the usual multitubular Scotch type with forced draft. When we were well started on our first voyage we found that the after glass on our starboard boiler was working faultily sometimes for hours showing full glass, then dropping to the usual working level and bobbing up and down with the motion of the ship. As we were having the usual trouble with our pumps and bilges, owing to the yard's workmen having made the bilges a receptacle for old waste bags, etc., and as the forward glass on that boiler was working properly, we did not investigate the cause of this eccentricity at the time, and passed along the word at the relief of the watch to put no trust in the after starboard glass.

Next watch, things running in fairly good shape, I lit a hand lamp and getting on top of the boilers proceeded to examine the connections to the water gage column. I suspected that the cause of the trouble was water accumulating in the piping somewhere and traced the pipe along the boiler, over the air casing to the front of the boiler. There were three or four bends in the pipe, and at the first glance I was satisfied the trouble did not lie in them. There was also a long horizontal length, but as it was well stayed and could not sag at any point, I knew it would be clear. During this brief inspection I had managed to accumulate considerable dirt, and a profuse perspiration, so decided to get off the top of the boiler and do some thinking where the atmosphere was more conducive to brain work.

In getting to the grating I had to pass over the steam valve to the water column on the boiler shell, and having a last look

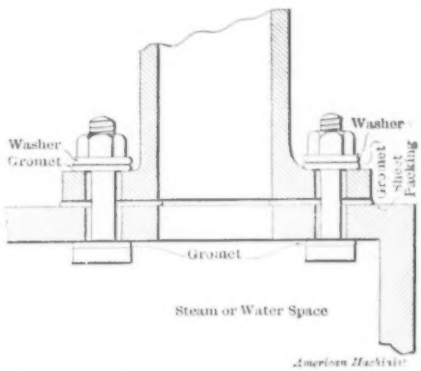


FIG. 2. SHOWING APPLICATION OF GROMETS.

at it, thought there was something peculiar in its setting; eventually deciding that my search was ended. On the port and center boilers the steam pipe to the column passed directly over the front of the boiler and the valve on the boiler shell looked in that direction, which was quite proper. On the starboard boiler the pipe passed to one side around the end of the boiler, as the casing prevented its being led over the front, and the valve looked to the side. Now, as the valve was not on the top of the boiler, but about 18 inches from the top, the outlet pointed slightly downward and the steam pipe connected to it also pointed downward for about 6 inches before bending upward, as shown by Fig. 1 at *B*, to go over the casing. The machinist on the job, seemingly deciding that the valve ought to face in the direction of the pipe, had fitted it accordingly. When the ship listed to starboard the condensation taking place in the pipe gradually filled this bend, and the pressure on the water end gradually forced the water up till it filled the pipe, also showing a full glass on the water column. On the ship straightening up or rolling over to port the water flowed back from the bend into the boiler, and the steam and water pressures equal-

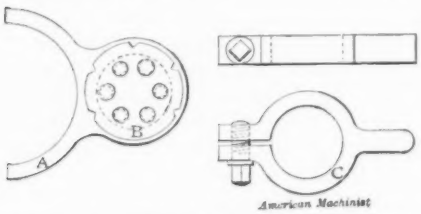
*A "gromet" is a washer which fits the bolt snugly. It is made generally of flax or hemp yarn—commonly called "spun yarn" at sea—and is thoroughly soaked with thick red-lead paint. It is placed under the head of the bolt next to the work, and under the usual washer and nut. It is used where the head of the bolt is thru into a water or steam space. Its object is to pack the bolt hole so that it will not leak (see Fig. 2).—Ed.

izing, we found our glass once more working—at least, this was how I reasoned it, fairly accurately, as subsequent events proved.

When we reached port we turned the valve with the outlet looking forward and had the pipe refitted. As no water could now accumulate when the boiler was under steam, we had no more trouble from that source. X. Y. EZEE.

Multiple Stop for Drill Press Spindle.

The illustration shows a drill stop for small lever presses. *A* is a bracket fast-



MULTIPLE STOP FOR DRILL PRESS SPINDLE.

ened to the frame of the press, having a sleeve *B*, with six adjusting screws in it having nurled ends at the bottom. It is stopped and held in place by a flat spring (not shown) engaging in the V-grooves in the top. *C* is a clamp to fit on the spindle quill and stopping on the adjusting screws in *B*. C. E. SIGLE.

Keying Hubs on Shafts.

Replying to J. C. Mather at page 827, Vol. 27, I will explain some features of the design shown by him, but with his kind permission will leave "talking points" to the gifted scientific and technical writers of the magazines and newspapers.

In selecting fastenings in machine construction, whether thru-bolts, studs, capscrews, keys, or other fastenings, the designer or draftsman must be governed by the conditions under which the machine is to be built and operated. Thus, Woodruff keys find extensive use in machine-tool construction; in engine or locomotive work, press fits without keys are used by many; for most kinds of heavy engine

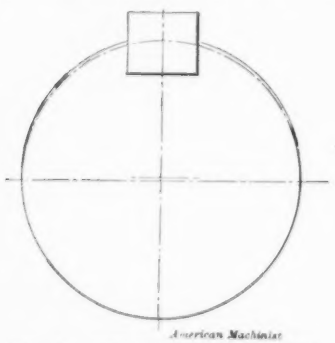


FIG. 1. THE PORTER-ALLEN KEY.

work, etc., the key used in the Porter-Allen engine, Fig. 1, and described in your columns at pages 432 and 481, Vol. 19, is unsurpassed, and other kinds of keys have their various uses.

In rolling-mill machinery, where 30-ton gears, 65-ton housings and 100-ton flywheels are not unusual, where breakdowns must, as far as possible be obviated, and repairs take the minimum of time, where the machinery is in almost continuous operation, under the terrific shocks of reversal, as well as the enormous working strains, the ordinary key which is subjected to a shearing stress will not do. With the ordinary key, under these conditions, we must have a tight key, and a tight fit between hub and shaft—in other words, place dependence upon both key surfaces and cylindrical surfaces. Then there is trouble in making renewals, and the gears often work loose on the shafts.

Fig. 2 shows more fully the details of the method Mr. Mather inquires about. Two taper keys with heads and of approximately square section are used, and usually driven in opposite directions. The shaft is an easy fit in the hub, so the gear or wheel can be readily removed when keys are driven out. The keys are fitted so that the wedging action is against the surfaces marked in the diagram in the upper right-hand corner of Fig. 2.

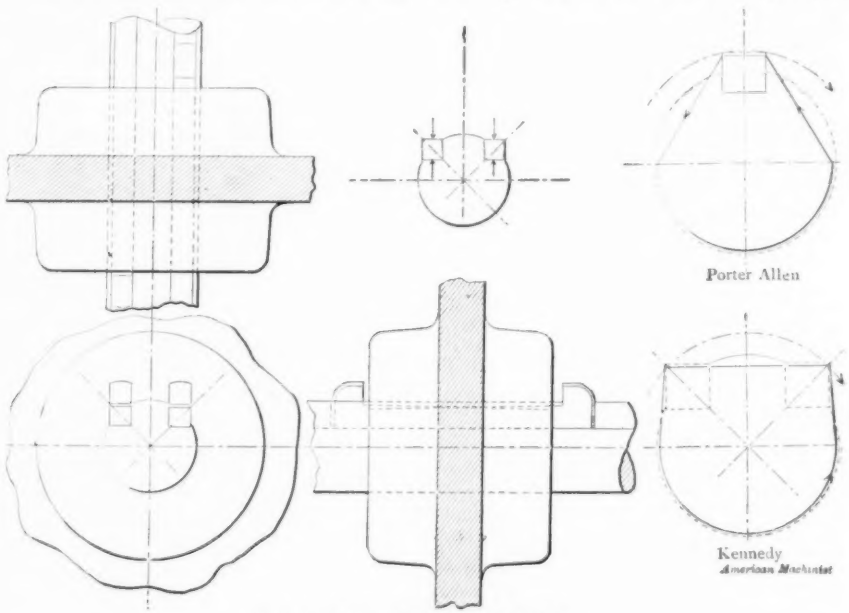


FIG. 2. KEYING HUBS ON SHAFTS.

Driving either key tightens both. It will be seen that one of the features of the method is that the keys are always in compression, and not subjected to a shearing stress. It is the shearing stress, coming first on one side of the key and then on the opposite side, caused by the continued reversal, that makes the ordinary key cause trouble in the mill.

When a journeyman I worked in the Pittsburg district for seven months, and saw them drive in keys, about 4x4x36 inches, with the "dolly bar," and it seemed nothing would ever get them loose. Machinists in charge of the big engines in the mills, however, said that those keys had to be constantly set up, and that the double key construction, which is in considerable use in that district, was preferable.

In Fig. 3, assuming that the keys in both constructions are in compression, and assuming a semi-circular bearing of hub on shaft opposite the key, as shown, then the figures may stand as a diagrammatic comparison of the two methods, the full line showing the course of strains in each case. In Fig. 3 the Porter-Allen key is shown square in section, while Mr. Porter used a thin, wide key. It will be seen, however, that the strains are more likely to be translated into a shearing action in the single than in the double key construction.

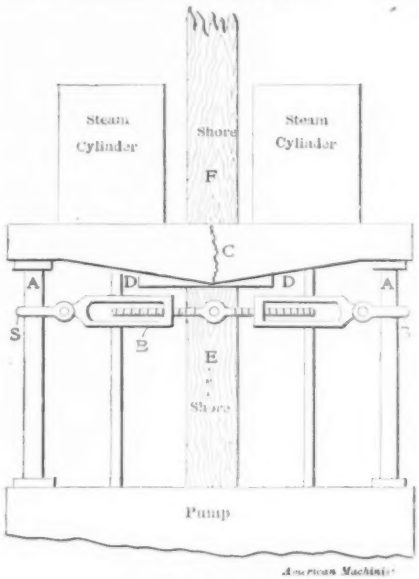
It is only fair to say that some of what I have here written does not differ very much from part of an article in *Machinery* of June, 1902. *Machinery* says that this method was developed by Julian Kennedy, M. E. I believe that Mr. Kennedy makes extensive use of this method, and probably introduced it in the Pittsburg district and elsewhere, but the article at page 1143, Vol. 19, AMERICAN MACHINIST, would seem to show that there is nothing especially new about it.

Referring to Geo. Wilson's article at page 967, Vol. 27, I fail to see the connection between the construction shown by Mr. Wilson and what Mr. Mather asked for. Mr. Wilson's article is of interest, nevertheless, and it may be interesting to note that a very similar key was shown in the AMERICAN MACHINIST at page 179, Vol. 20, and that the Hart Bros. Machine Company, Clarksburg, W. Va., say of it at page 277, Vol. 20: "The key represented has been in use in our works for at least twenty years. We have found it to hold where other keys have failed. For holding pulleys and engine cranks on the shaft of direct attachment sawmills, the crank being on the same shaft with the saw, we found it to be the only key that would give satisfaction."

F. WERTHEIM.

A Temporary Repair.

When trouble comes to the marine engineer in the form of a breakdown, he starts in to repair the damage with varying hopes and fears, meanwhile trusting to luck that the first method adopted will be the right one, and the gear selected the most suitable for the job.



A TEMPORARY REPAIR.

I give the following as an instance of a temporary repair which, tho a quick job, was none the less satisfactory:

The third engineer of our ship, taking his periodical walk round on watch one day, happened to notice a peculiarity in the working of the air pump, which was of the independent vertical type, her two steam cylinders being mounted on a platform supported by four columns on the base. The peculiarity was nothing less than a distinct rise and fall at the center of the platform, with each stroke of the pump. On closer inspection he found that the flanged edge of the platform, which was about 5 inches deep, was cracked and the crack was opening with each stroke of the pump. As it was necessary to stop the working of the crack and prevent further damage, and as it was impossible to stop the pump at that time long enough to thoroughly repair the damage, a temporary repair was made with the facilities at hand, as follows: A large shackle *S* was put around each column *A* on the cracked side of the platform near the top. A large turnbuckle *B*, used for raising cylinder heads, etc., on the "traveler" in port, was next opened out between the columns till the bolts of the shackles could pass thru the ends of it. On tightening up the screw the crack *C* gradually closed and eventually the heaving motion of the platform ceased.

To reduce the strain on this rig as much as possible, a long shore was placed on end, reaching from the sole plate to near the cylinder platform. The wedges *D* were inserted between the top of the shore *E* and the flange at the crack, making a solid support. Another shore *F* reached to the deck beams overhead.

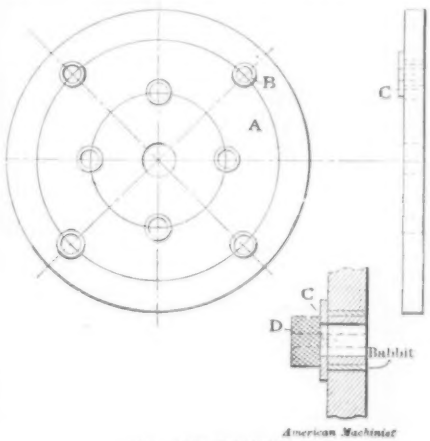
This makeshift repair didn't take long, was quite satisfactory, and gave no trouble during the remainder of the trip. On our arrival in port a large patch was fitted to the flange (with bolts) of such a length that it not only repaired the damage, but increased the strength of the flange, which was rather weak for the strains exerted on it. A patch was also fitted on the top of the platform to further strengthen the repair.

X. Y. Ezee.

Spacing Holes in Large Rings.

Seeing an article at page 56 on the above subject prompts me to describe a method I have used in making large ring jigs or large jigs in general, in which the holes must be spaced very accurately.

The sketch gives a rough idea of what I mean. I take a ring *A*, as it comes from the boring mill, lay off the holes *B* according to specifications, and then drill them ⅜ or ½ inch larger than bushing *C*, which is made of gray iron or soft steel, as the case may require. This bushing is made with a flange or shoulder ⅜ or ½ inch thick, the flange being large enough in diameter to receive two screws and two dowel pins, and the hole is drilled and reamed to receive the hardened drill reamers or tap bushing *D*. I must have, as you see, one bushing for each hole in the drill jig, and these bushings being smaller than the holes in the jig, can be shifted in any direction. I place them approximately in the right position, lay off and drill the screw holes and fasten each bushing in the proper hole, then rap the bushings to their exact positions, finally securing them with dowels. The



JIG AND BUSHING.

jig, to insure strength, can now be turned over and the open space around the bushings filled with babbitt metal. I have found this method to bring good results, as a jig that has a lot of large holes is very apt to spring. I have made a large ring jig containing twenty holes 3¼ and 4 inches in diameter and, after rough drilling and testing it, found that one of the sides had dropped 0.040 inch. So if it was required to be very accurate, the jig could, after drilling, be put into the mill and be faced true.

This method can also be used in altering holes. I once made a jig for a gear box, and thru an error in the drawing room two gears were meshed too closely; this, by the way, was not discovered until the machine was being assembled. I then used this method to correct the mistake.

W. J. N.

A Bit of Shop Experience.

This is a new yarn that I got from a prominent manufacturer of instruments of precision. I obtained permission from him to write it for the American Machinist on condition that the names of all parties concerned should be suppressed. He was brought up in his father's shop which in due time he inherited. He is an excellent toolmaker, as well as an efficient office man. If there be one thing more than another upon which he prides himself it is upon the high state of perfection to which he has brought the instruments which he manufactures; but, good as they are, they have not yet been brought to the standard which he has set for them—absolute perfection. For the sake of my promise I will call him Jones.

At one time Mr. Jones found himself all run down with worry and work, and decided that a vacation away from that part of the country in which his factory was located would be just the tonic to put him on his feet again. So off he went to a region noted for toolmaking and small metal ware manufacturing. The first thing he did was to apply for a job as toolmaker and under the assumed name of Bones he was taken on at $3.50 per day. The foreman toolmaker questioned him about his ability, asking him if he could design and make jigs. On receiving a reply in the affirmative he brought out two samples of work and said: "Go ahead and make a drill jig for drilling these pieces, the holes must be central; you will see that while the pieces are round they vary in diameter—there; that ought to hold you for three weeks."

So toolmaker Bones started in on this job, which he found out subsequently was the stumbling block which was given to every new man who started in that shop. Just by luck the principle which he decided was applicable to this jig was a hobby of his, *i. e.*, the spring collet, so he laid out his jig and started on it. From the very first he suffered all kinds of annoyances from the men on either side of him. He was using a micrometer and on returning to his bench after a few minutes' absence it was gone and an old one left in its place. He kept cool and at dinner time bought a new one.

The toolmakers in this shop were not allowed to do their own milling, but took it to a milling machine hand who got it for them. From the milling machine hand he received the same treatment accorded him by the toolmakers, so was obliged to

file certain parts that ought to have been milled. At the end of two and a half days the job was near enough completion for him to test it, which he did upon two pieces he got in the shop, and seeing the evident antagonism of the foreman he put these pieces in his pocket for future reference. After drilling the samples he went to the foreman and told him that the job was nearly completed and that he would like him to look over the job. After a while along came the foreman, who looked the job over and said at once that it would not work. "And why won't it work?" said Bones. "Because it won't, it's all wrong, and besides when I gave you the job I told you it would hold you for three weeks; you'll get every man in the place out of a job." "But," said Bones, "who tests the jigs? I want that jig tested before I'll believe it won't do the work." "*I* test the work," replied the foreman, "and when *I* say that jig won't work that settles it, so the best thing you can do is to go and get your money. I don't want you here any more, you've too d——d much to say. This jig which you think so much of goes into the scrap heap where it belongs."

That evening, as Mr. Jones sat at dinner in the best hotel in the town, who should come in and sit at the next table but the superintendent and president of the concern for which he had been working as Bones, the toolmaker. They had been customers of his and he knew them personally. "Why hello, Mr. Jones, what are you doing in town?" "Nothing at present, but I have been working for you as a toolmaker under the assumed name of Bones for the last three days. I was discharged to-day for incompetence."

Knowing Jones' ability they thought this was a joke on his part, but he assured them that he really had been working in their factory. "Do you know," said Jones, "that you are being robbed right and left under your very noses?" "How's that?" said the president. So Jones told them the story of the jig that took three days to build, which according to the foreman ought to have been soldiered along for three weeks, and to the completion of which in three days his discharge was due.

So it was decided that Jones should come in the next morning and face the foreman along with the superintendent.

Bright and early the next morning Jones presented himself at the office of the factory with a shiny plug hat on his head and a 25-cent cigar nestled under his drooping mustache. The superintendent was there, and the foreman was sent for. He was struck dumb with the festive appearance of his late underling.

"Was this *gentleman* working for you in the toolroom, Jackson?" "Yes, sir; he's been with us three days, but I discharged him yesterday." "What for?" "Oh, incompetence. The work he did is not up to *our* standard." "Not up to our standard? Why, man, you don't know what you are talking about; this *gentleman* is Mr. J. J. Jones of the Jones Manufacturing Company, maker of fine instruments—why, *his* standard is as far above *yours* as yours is above that of a sash-weight foundry. Where is the job he did?" "I've got it in my desk?" "In your desk?" said Jones, "you told me it would go to the scrap pile." "Yes, I told *you* it would go to the scrap pile, but I guess I'm foreman here and can put a job in my desk if I want to." Well," said Jones, "go and get it." "I won't for you." "Well, then, get it for *me*," said the superintendent.

So Jackson ambled off and was gone some time, finally returning with the jig. It was a work of art, for Jones was riding his hobby when he made it, and he had taken as much care with it as he would have done with a sextant.

"Now," said the superintendent, "what's the matter with it, Jackson?" "Oh," said Jackson, "it's pretty well made, the work is fair, but the principle is wrong, and besides you can't test a drill jig by looking at it; the proof of the pudding is the eating, and the proof of that jig is the work it will do."

So out into the shop they all went to test the jig. By this time the president had arrived and joined them. A lot of the pieces were obtained and drilled, each one of them drilling in turn, then the jig was handed over to the drill-press hand and he drilled some pieces.

Jackson spoke up: "It's all very well to look at these pieces and admire them, but I know they are not right. Say, Billy (to the drill-press boy) go and get the test gage for these pieces from the toolroom." The test gage was brought and tried on several of the pieces. Things began to look pretty black for Jones, for none of them fitted the gage. Jackson began to be triumphant, and altho he said nothing his face wore that "I told you so" look.

Just then Jones got in a word: "Lend me the gage a minute," and taking the two pieces he had drilled the day before he tried them on the gage; they did not fit. "That gage is wrong, the pieces are right, the gage has been *fixed;* these two pieces I drilled yesterday on that jig, and yesterday they fitted the gage, to-day they won't."

So the gage was tested and found wanting, as was also the foreman. The former was fired into the scrap heap and the foreman out into the cold world. Jones got his three days' pay and went back home, where I met him the other day. He is making better instruments to-day than he was last year, but not as good as he hopes to next year; but what bothers him most of all is not why Jackson tried to down him, but why his fellow-workmen were so antagonistic to him. He and I settled it by applying the old adage, "Like master, like man." Were we right?

DAMASCUS.

Micrometers and Decimals.

BY E. H. FISH.

The article at page 164 by W. S. Rowell interested me greatly, tho I cannot agree with all that he advocates. There are two conditions under which a draftsman may work: one where he is supreme and whatever he gives to the shop must be accepted by them as final without a murmur; the other where the shop is the important element and the draftsman's work must be such as will aid the shop to the greatest possible extent and where his work is subject to criticism. With the first I have had no experience, but the latter I have seen from both sides. Then, again, there are varying conditions in different shops; in some dimensions given in thousandths bring out micrometers, in others they stagger the men.

To some used to micrometers it is incredible that there are shops doing the highest grade of work in which a micrometer is an almost unknown thing. I have seen right here in New England fifty men of above the average ability, working together, and not a micrometer caliper among them. Probably not more than five would have known how to read one if they had had it.

Suppose you give such men a dimension in odd thousandths. They cannot touch it. Not but that I believe in measurements so given when dealing with men that can use them, but the point is that comparatively few men can handle them and almost none if the dimensions are over an inch; and, by the way, it seems remarkable to me how many micrometers are used when I consider that almost all that are sold to workmen are limited in capacity to one inch. How can they find much use for them in the rank and file of shops?

The ideal condition would be that we should, if we want work done within close range give our measurements in thousandths, and let it be understood that a measurement so given as 1.275 inch or 1.000 inch must be accurate, say, to within a quarter of a thousandth above or below that measurement. One given to hundredths, as 1.27 inch, must be accurate within a quarter of a hundredth, etc. This would give us a ready means of showing the accuracy needed. Then, if every workman could be readily provided with means of measuring all dimensions given him to a quarter of a thousandth, we would be in clover. Since we cannot usually give the workman such a range of measuring machines we have to do the next best thing.

It is natural for us to divide by two and keep on so dividing. This gives us quarters, eighths, etc., and our scales are so divided, our taps and reamers are so marked. This being the case, suppose that in about the average of shops we have a call for a shaft marked on a drawing 3⅜"—.005, which Mr. Rowell dislikes. There is no excuse for the separation of the figures, to which he refers, and, as we

are not excusing anyone's bad workmanship, we will pass that over. In average shops as I have seen them we can find a micrometer up to an inch—not over 2 inches—but they have reamers that, if not standard are not much under, and arbors to match. The workman naturally selects a piece of paper or a number of pieces that make up a thickness of .005 inch. Then he makes his shaft of such a size that when calipered together with these pieces of paper it will be the same as the 3⅜-inch arbor. Since a much smaller amount than a quarter of a thousandth can be readily detected by calipers, the probable error is reduced to the amount which the reamer in the shop is worn. What this error is depends on the care which the shop takes of its tools.

Possibly also this measurement may be given the way it is in a shop where the only reamers in use are shell reamers ground and marked .005 inch under size. It is not strictly correct in such a case to mark a hole to be reamed 3⅜ inches when it is intended to be .005 under that size; but if we mark the drawing "Ream 3.370 inch," how many men will recognize their old acquaintance 3⅜" — .005, which they have seen every time they used the reamer?

The same applies to taps and dies for rough iron. These are always marked with their nominal size plus 1-32 inch, as 1¼" + 1-32. This is a matter of long habit. Can you imagine a man whose mental capacity ended at a bolt-cutter job, understanding that 1 9-32 inches meant what he would call an inch and a quarter die? The fact is that the rank and file of machinists dislike to use fractions finer than sixteenths, except as a thirty-second or a sixty-fourth greater or less than some other fraction. I must confess to a similar feeling.

The use of the inch mark either " or *in.* where small measurements are used seems to me only likely to cause confusion, as 4⅜ on a drawing in this country is not likely to be mistaken on any ordinary scale for feet, or millimeters, or anything else.

If a long dimension is wanted with considerable accuracy, there is little or no choice whether it is given in feet and inches or in inches alone. The chances are that the workman will use the yard as his unit. To explain: Suppose he has a measurement of 86⅝ inches to lay off. Almost any shop will afford two 3-foot scales, or yard sticks. He clamps one on the work with one end against one end of the line to be measured. Then he clamps the next one against the end of that, and has thus laid off two yards, or 72 inches. This leaves him 86⅝ inches — 72 inches, or 14⅝ inches to lay off beyond the second scale. If the work is rough and the workman is likely to use a ten-foot pole, it is better to give him feet and inches to use over a two- or three-foot measurement.

The use of scales of other divisions for gear diameters is certainly justifiable, tho their reduction to thousandths where micrometers of large size can be had might be a good thing. But in all these cases it would be wise for the draftsman to be sure that his drawings are to be used only by men who can understand them, or, to put it the other way, "when in Rome one must do as the Romans do." He must be willing to adapt himself to the usages of the shop for which he is making drawings.

Convenient Metric Conversion Table.

C. H. Nicolet, of LaSalle, Ill., sends to *Engineering News* the table which we print below and regarding which he says:

I send herewith an excellent little conversion table which has had a place in my pocket note-book for many years, and has proven very useful. It is sent to you with the belief that it may be appreciated by other engineers. The arrangement of the table is especially commendable, as the entire conversion process is at once apparent, thus:

M = (millimeters) × .03937 = I (inches)
or, reversing,
I (inches) × 25.4 = M (millimeters).

Millimeters	×	.03937	=	Inches.
"	=	25.400	×	"
Meters	×	3.2809	=	Feet.
"	=	.3048	×	"
Kilometers	×	.621377	=	Miles.
"	=	1.6093	×	"
Square centimeters	×	.15500	=	Square inches.
" "	=	6.4515	×	" "
Square meters	×	10.76410	=	Square feet.
" "	=	.09290	×	" "
Square kilometers	×	247.1098	=	Acres.
" "	=	.00405	×	"
Hectares	×	2.471	=	"
"	=	.4047	×	"
Cubic centimeters	×	.061025	=	Cubic inches.
" "	=	16.3866	×	" "
Cubic meters	×	35.3156	=	Cubic feet.
" "	=	.02832	×	" "
" "	×	1.308	=	Cubic yards.
" "	=	.765	×	" "
Liters	×	61.023	=	Cubic inches.
"	=	.01639	×	" "
"	×	.26418	=	U. S. gallons.
"	=	3.7854	×	" "
Grams	×	15 4324	=	Grains.
"	=	.0648	×	"
"	×	.03527	=	Ounces, av'dupois.
"	=	28.3495	×	" "
Kilograms	×	2.2046	=	Pounds.
"	=	.4536	×	"
Kilog's per sq. centimeter	×	14.2231	=	Lbs. per sq. inch.
" " "	×	.0703	×	" " "
Kilogram per cubic meter	×	.06243	=	Lbs. per cubic foot.
" " "	=	16.01890	×	" " "
Metric tons (1,000 kilog's)	×	1.1023	=	Tons (2,000 lbs.)
" "	=	.9072	×	" "
Kilowatts	×	1.3405	=	Horse-powers.
"	=	.746	×	"
Calories	×	3.9683	=	B. T. units.
"	=	.2520	×	"
Francs	×	.193	=	Dollars.
"	=	5.18	×	"

METRIC CONVERSION TABLE.

The Industrial Economic Department of the National Civic Federation will meet March 24 in New York, and will discuss the question, "How far does associated effort in industry involve the curtailment of individual liberty?"

A School Shop.

The Washburn Shops of the Worcester Polytechnic Institute, thru their foreign agents, will exhibit a universal drill grinder at the international exposition to be held during the coming summer at Liege, Belgium.

The senior class in the mechanical engineering department have started on the new course in shop management under Professor Bird. The first problem is on the 14-inch drill press. These are made in the Washburn shops in lots of fifty, so that data for each piece can be obtained from the regular time cards returned by the workmen for each operation. The results are tabulated on a large cost sheet, so that the comparative cost of each lot can be made. This study will be continued so that students will become familiar with everything that is done, from the receipt of an order for a drill to the time of its completion, and how it is shipped, billed and paid for. This will require the expenditure of some time in the office, with an opportunity to learn something of accounting. The students will also, while working on time-keeping, make out the regular shop payroll, which now amounts to over $800 per week. The Worcester Polytechnic Institute is the only engineering school in the world which can offer any such practical experience for undergraduate students.—*Boston Transcript.*

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Micrometers and Decimals.

In the article published elsewhere in this issue under the above title statements are made which we feel sure will be a great surprise to many of our readers, who will find it difficult to believe that there can be, in this day and age, shops in New England, or anywhere else in this country, doing first-class work, entirely without the use of the micrometer caliper—shops in which there are few, if any men who can handle decimal fractions or are able to form an idea of the size of a piece when expressed decimally.

There is, however, no reason to doubt the accuracy of the statements of Mr. Fish. They simply illustrate once more the often observed fact that, long after the sun of enlightenment has risen and is shining brightly over the general surface of the earth there will be depressions where his rays have not yet penetrated. For it can be said most positively that such a shop as that described is not enlightened. It makes no difference how good its finished work may be, that work is not, and cannot be, produced by the best modern methods unless free use is made of decimal divisions of the inch, and the micrometer caliper. It is as much a mistake to suppose that micrometer calipers are of use to those only who are "violently fine haired" as it is to suppose that modern grinding machines are used only for adding refinement to and piling up costs of machine construction. The micrometer gives definite information regarding processes of machine construction. It readily and quickly answers the questions, how much? how big? and its answers are in definite terms that mean the same thing always and to all men. It does away with the uncertainties of "scant" and "full" and "strong" and "slack." It tells the intelligent man just precisely how much too big a piece of work is—tells him in terms that have a definite meaning and does it far more quickly than he could determine whether or not the work is "full" or "scant," and if so, whether it is "full" or "scant" by about the right amount.

The precision of fitting required in machine construction goes far beyond the possibilities of the ordinary common divisions of the inch. Decimal divisions are necessary if the relations of different parts of a machine to each other are to be expressed at all, in any terms whatever, that mean anything. Those who are really intelligent, judged by present-day standards of machine shops, must know in definite terms how much larger a shaft must be than the hole it is to be pressed into or to which it is to be a shrink fit. It will no longer do to have in the shops one or two men who, by long experience, can judge by the "feel" with calipers or who know how many thicknesses of a given paper to put under the calipers in order to bring right results. Such methods were all right in their day, but their day is past, and there is now a better way. The allowance must be known in thousandths of an inch and must be a matter of record, to be placed upon the drawing. This is not mere fine-haired refinement, it is simply the application of definite means to the accomplishment of a definite object, instead of guessing or "jumping at it," with the moral certainty that no two men in the shop will jump at it in precisely the same way.

It happens that the same mail which brings Mr. Fish's article brings also an article which relates to the maintenance of standards and of interchangeability in the bolts and nuts made and used by a large manufacturer of agricultural machinery. With this article is a blueprint table giving certain dimensions and limits of gages and of taps in thousandths of an inch, and we have reason to believe that these dimensions and limits are closely adhered to in the establishment from which the article comes. This is not done, we may be sure, for the purpose of increasing the cost of the bolts and nuts, but rather to decrease it. Nor is it done for the purpose of adding a degree of refinement not called for by the character of the work, but simply to enable the manufacturers to know what they are doing—to be intelligent regarding the work they are putting out—to know just precisely *how much* play there may be as a maximum between any nut and any bolt that may happen to come together in assembling, and that no nut will ever be found that will not go onto its proper bolt.

In the AMERICAN MACHINIST of May 12, 1892, is an article describing a systematic scheme and the tools for maintaining threads of bolts and nuts to a close approximation to the United States standard when made in large numbers and whether in the lathe, screw machine or bolt cutter. It is reprinted in part in Kent's Mechanical Engineers' Pocket Book as probably the best and most thoroughly worked out plan for maintaining a standard in bolt and nut manufacture. It was devised by the late Charles A. Bauer at a time when he was mechanical head of a very large establishment manufacturing agricultural machinery. All limiting sizes are there given in decimals of an inch, some of which are carried to four places. This of course does not mean, as the ignorant scoffer would have it, that bolts and nuts made in that establishment are pretended to fit each other within the ten thousandth part of an inch. It simply means that all the various dimensions of the gages and of the taps and dies to be used were computed to that number of places and a definite limit of variation fixed for them and set down in figures having a definite meaning to a man with a micrometer in his hand and the intelligence to use it. How would such a scheme be devised or adhered to by men who set their calipers by graduated rules, or who might attempt to do it in any other way than by the micrometer?

We all know that two pieces of work may be fitted together as accurately without a micrometer as with it. But nearly always they can be fitted more conveniently, more quickly and more cheaply by using the micrometer, and if we are to know what the actual size of either piece is or *how much* the size of one differs from that of the other the micrometer is necessary.

The writer hereof knows by personal experience that every-day use of the micrometer caliper with a table of decimal equivalents soon enables one to translate mentally from thirty-seconds, sixty-fourths, etc., to thousandths and *vice versa*, and that when this familiarity is acquired it is much the preferable way to give actual dimensions of a piece in thousandths "straight" rather than to give them in such an abominable mixture as ¾"—.002". This means that the piece is to be .748 inch and the men soon grow accustomed to such dimensions and know at a glance that the figures mean 2 thousandths less than ¾ inch when they have occasion to pay attention to that aspect of the case.

There is no doubt that one of the most awkward and expensive things connected with American machine shops to-day is the fact that we use a mixture of common and decimal divisions of the inch, and are constantly spending time and energy in translating from one to the other. We use the former because we have inherited them from a time of relative crudity and of bygone conditions. We use the latter because the former simply will not do for modern, systematic, refined and highly developed methods of machine construction. The less the two are mixed the better for all of us.

New Tools and Machine Shop Appliances.

HORIZONTAL SPINDLE BORING, DRILLING AND MILLING MACHINE.

The accompanying illustrations show a new machine by the Newton Machine Tool Works, Philadelphia, which has some highly interesting features. It has power feed and quick traverse in three directions—in line with the spindle, vertically on the post and horizontally on the bed. Structurally, the saddle is mounted on the post in a manner which gives great rigidity. The post is faced upon two sides, giving bearings at three corners, gibs at the extreme corners drawing the saddle solidly against both faces of the post, while at the same time the saddle hooks around both extreme corners. The spindle and the feeds of bar and saddle are driven thru a steep lead worm by the main motor of 5 horse-power, while the feed on the base is by a separate motor of 3 horse-power arranged as shown most clearly in Fig. 2. Thru gearing at the farther end of the motor shaft the upper horizontal shaft is driven, a set of variable friction disks driving the lower shaft upon which is mounted the feed worm meshing with a worm-wheel upon the inclined shaft having a hand-wheel at its upper end. The first friction disk shaft has also a worm meshing with a second worm-wheel upon the same shaft as the first, this second worm giving the quick traverse. The worms are engaged by a clutch operated by the hand-wheel. The inclined worm-wheel shaft has a spiral pinion upon its lower end which meshes with a rack on the inside of the bed.

The speed of the 4½-inch spindle is varied by both mechanical and electrical means. The spindle feed has a range of 32 inches with six changes. The saddle has six changes of feed, the extreme distance of the center of the spindle from the floor plate being 6 feet 4¼ inches. The feed of the post on the bed is 15 feet, tho this may of course be varied or omitted altogether.

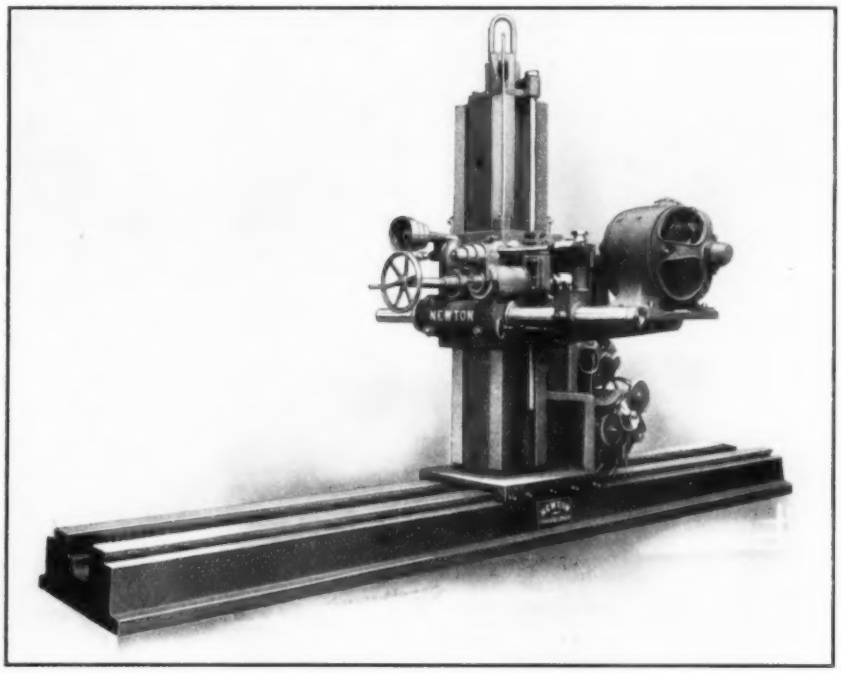


FIG. 1. HORIZONTAL SPINDLE BORING, DRILLING AND MILLING MACHINE.

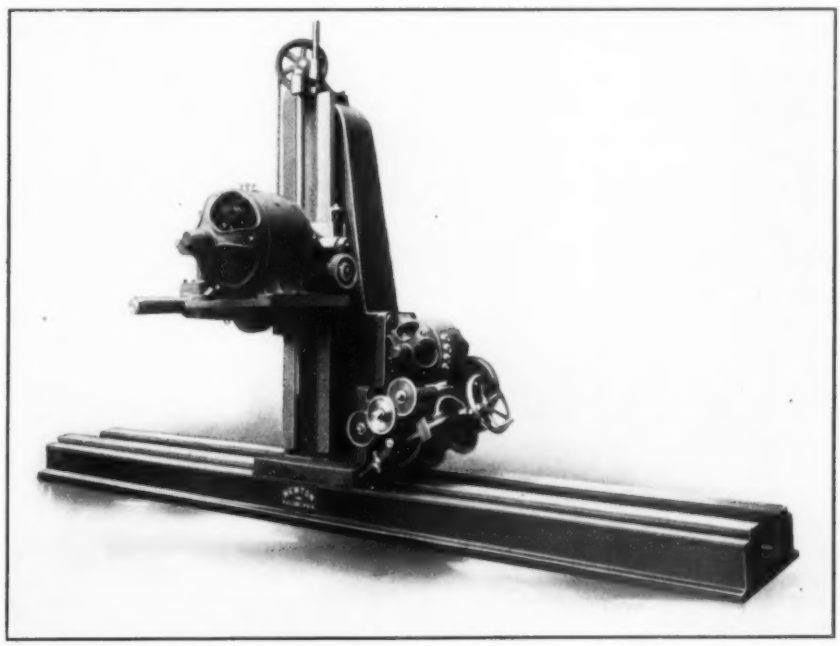
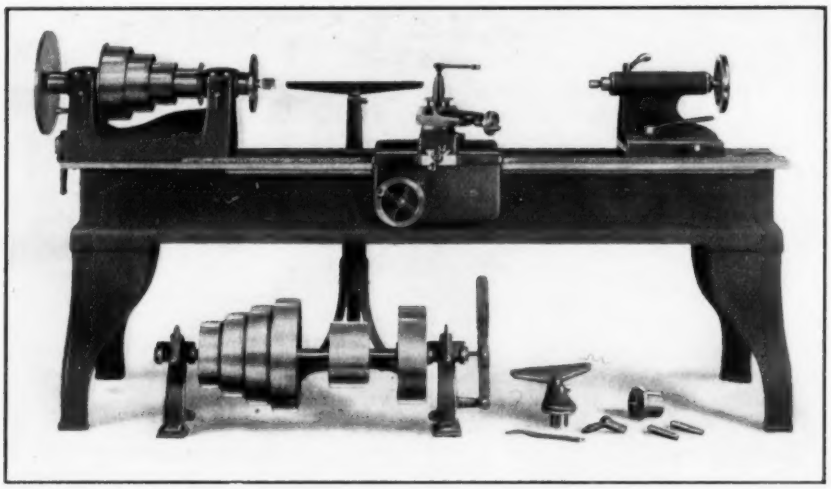


FIG. 2. HORIZONTAL SPINDLE BORING, DRILLING AND MILLING MACHINE.

NICKELUMEN.

Nickelumen is not babbitt metal, but is a nickel-tempered aluminized white bronze which fuses at a temperature sufficiently low to allow it to be melted and recast from an iron vessel. It is claimed to have



ROBBINS' PATTERNMAKERS' LATHE.

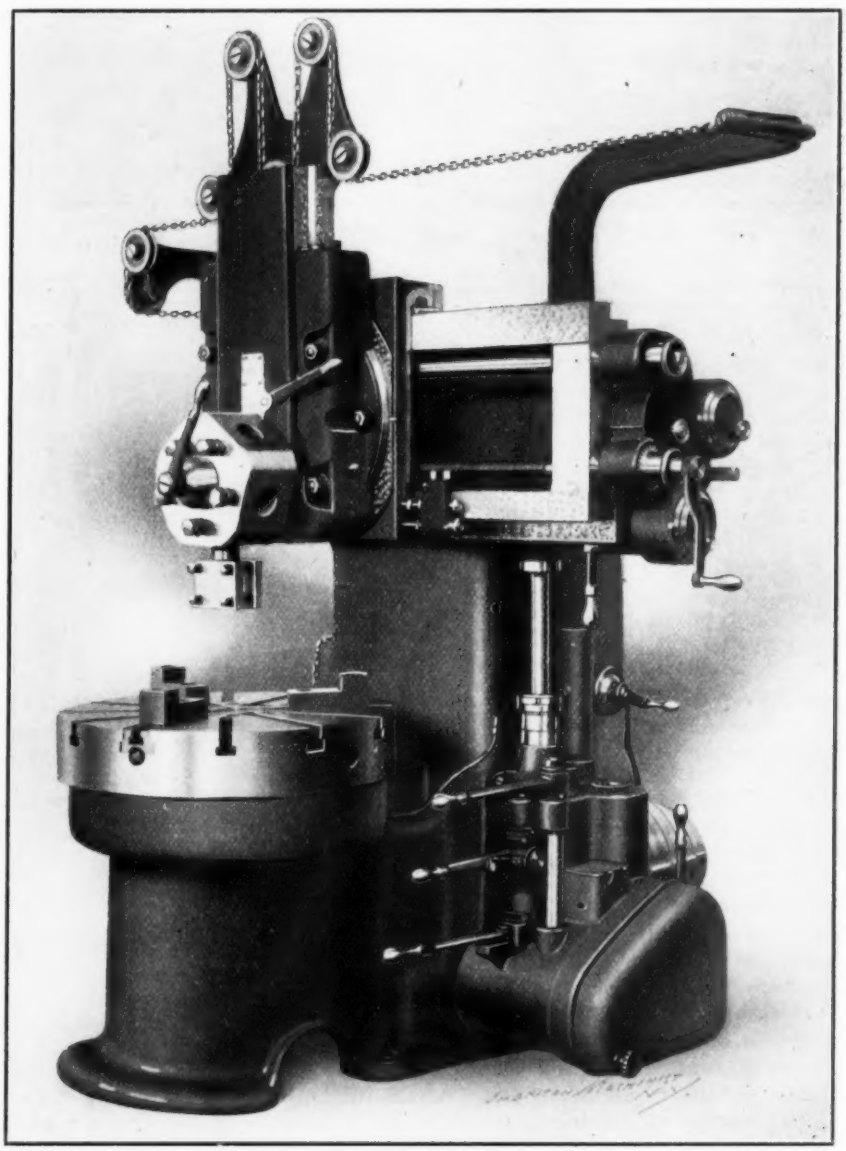
the remarkable quality of parting very slowly with the heat which it absorbs upon fusing, which makes it possible to pour it into journal bearings the same as babbitt is used; hence by its use a fine quality of bronze bushings can be secured without the expense of machine work. The wearing quality is claimed to equal that of the best red or yellow bronze. Nickelumen cannot be alloyed with babbitt metals which contain lead, as neither nickel nor aluminum amalgamate with that metal under ordinary conditions. Nickelumen is made for the market by the New Era Manufacturing Company, Kalamazoo, Mich.

ROBBINS' PATTERNMAKERS' LATHE.

The half-tone shows a new patternmakers' lathe brought out by L. Robbins, Worcester, Mass. It is built in two sizes, 20 and 24 inches, and corresponding lengths of bed. The lathe illustrates the progress which is being made in accepting in the pattern shop the facilities familiar to the machinist, the present example embodying features unusual to tools of this class, but whose desirability is manifest. The headstock, for instance, is swiveled and also graduated in degrees and is provided with a quick-acting cam binder. The spindle is of high carbon crucible steel and runs in phosphor bronze, with ring oiling bearings which will not throw or drip oil, and reservoirs of capacity sufficient for a long time of service. The spindle extends thru at the back, carrying a large face plate for work that will not swing over the bed. The cone, turned inside as well as outside and perfectly balanced, has a locking pin to hold it when a faceplate is to be unscrewed. The friction countershaft has two speeds, thus giving eight speeds to the lathe. The tailstock sets over for turning tapers; the spindle is of large diameter and has long travel. The carriage is stiff, with large bearings on the ways and a hand feed the whole length of the travel. It has a compound rest with graduated swivel base. This rest is instantly removable in exchange for the hand-tool rest holder. The bed is deep and stiff and thoroughly tied. The countershaft has self-oiling pulleys and boxes and balanced cone. Tripod rest, wrenches, centers, etc., are provided.

37-INCH BORING MILL.

The accompanying illustration shows a new size of the line of boring mills which are being made by the Gisholt Machine Company, 1315 Washington avenue, Madison, Wis., a full description of one of the larger sizes of which was given at page 911, Vol. 27. The present machine has many of the features of the larger size, including micrometer dials to the feed screws which are shown at the end of the cross-rail, but details of the driving and feed gears are modified from the larger machine. The drive, which on the larger machines is of the constant speed pulley type, is here obtained thru a cone pulley, back gear and two-speed countershaft, the combination giving sixteen speeds. The machine is fitted with screw-cutting gear, the manipulation of which will be apparent from the engraving and the following description of it. The small lever hanging from the end of the cross-rail reverses the direction of the feed and the small crank lever immediately below it adjusts the feed, the rate being shown



37-INCH BORING MILL.

upon a dial. Of the three parallel lines which project toward the front of the machine, the upper one engages and disengages the screw-cutting gears, its office being the same as that of the split nut on a lathe carriage. The lever below it operates a back gear in the feed train and thus doubles the number of feeds and the lower lever changes the machine from the usual

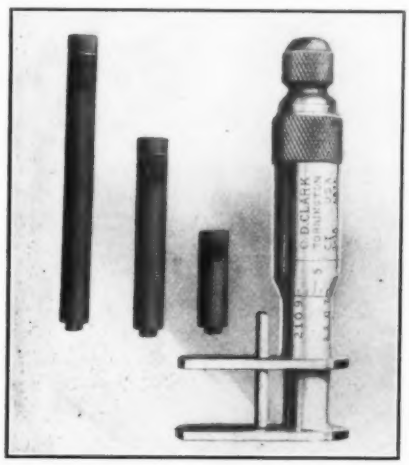


FIG. 1. MICROMETER HIGHT GAGE.

to the screw-cutting feed, and *vice versa*. The vertical lever in the rear operates the back gear of the driving train. Upon the lower edge of the cross-rail is a regulating device for the depth of cut when cutting screws. After taking a cut the operator releases a screw of this device, and for the next cut he runs the head up against this screw stop. The machine is also made without the screw-cutting attachment and in still simpler form with a belt feed.

MICROMETER HIGHT GAGE.

Fig. 1 shows a new micrometer hight gage made by C. D. Clark, Torrington, Conn. This tool will measure by thousandths from 3-16 inch to 1¼ inches without the extension pins shown in Fig. 1, and with the extensions all hights to 4¼ inches are obtainable. It can be used for measuring the width of slots, etc., over 3-16 inch wide. As a sizing block for setting shaper or planer tools, Fig. 2, it leaves little to be desired. The measuring plates and extension pins are of tool steel hardened and ground. The nurled nut at the top of the barrel is for locking the tool after setting is obtained.

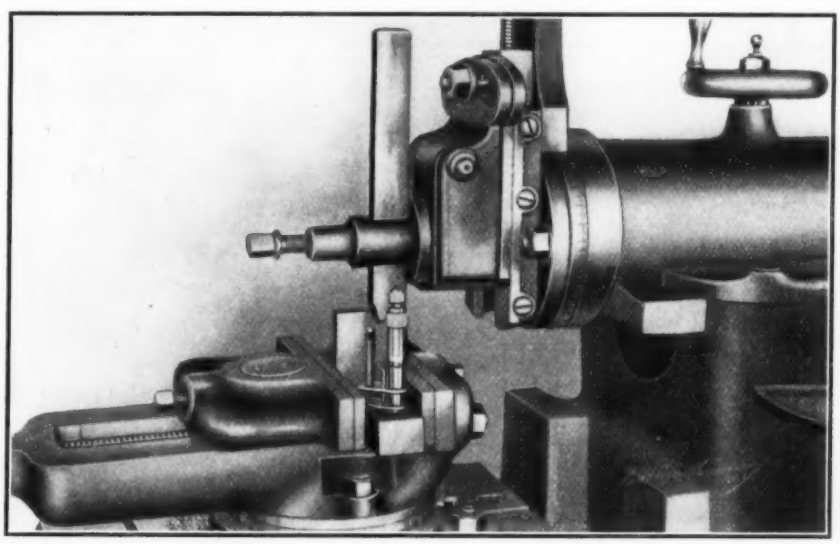
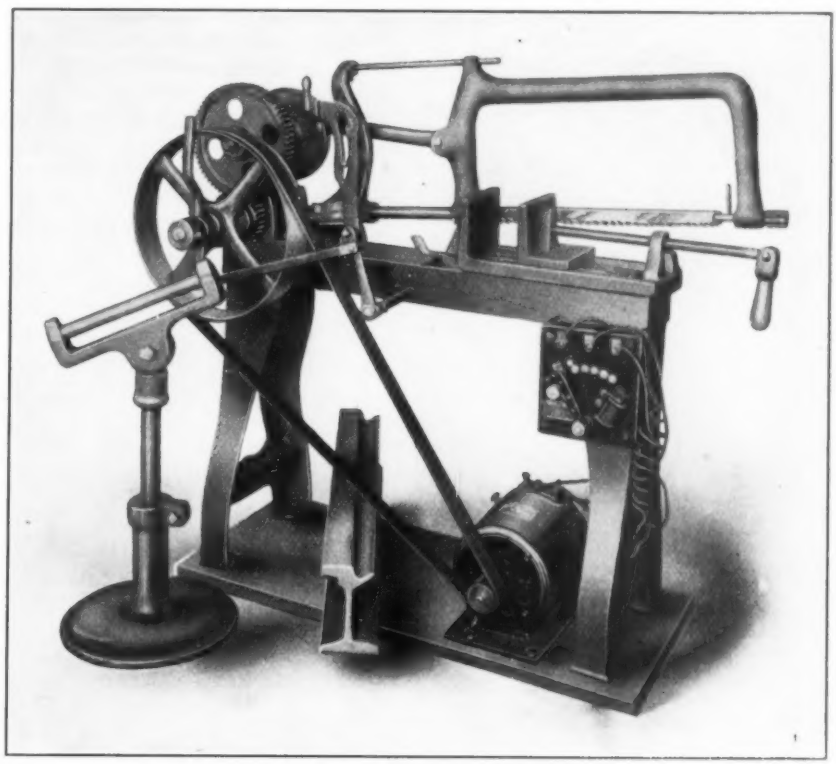


FIG. 2. HIGHT GAGE AS A SIZING BLOCK.

A POWER HACK SAW.

The illustration shows the latest development of Robertson's rapid cut power hack saw, made by the Robertson Manufacturing Company, Buffalo, N. Y., and which we illustrated and described fully at page 37, Vol. 26. The machine illustrated is back geared and motor driven.

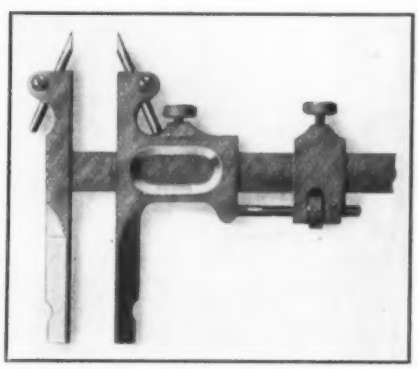


A POWER HACK SAW.

This line of power hack saws is built with plain and back gear, belt and motor drive, in capacities ranging from 4x4 to 8x15 inches, using saws from 12 to 24 inches long.

IMPROVED CALIPER.

This tool is the "Columbia" vernier caliper fitted with a pair of adjustable points at one end of the jaws, the latter being drilled at an angle with the jaw faces, split and fitted with clamping screws. The small points may be used for laying off work; or, by grinding properly, for measuring screw threads, and for various other purposes which will suggest themselves to the toolmaker. E. G. Smith, Columbia, Pa., is the maker.



IMPROVED CALIPER.

UPRIGHT DRILL WITH POSITIVE GEARED FEED.

Fig. 1 shows the most recent improvement in upright drills manufactured by the Cincinnati Machine Tool Company, Cincinnati, Ohio. It will be seen that the feed

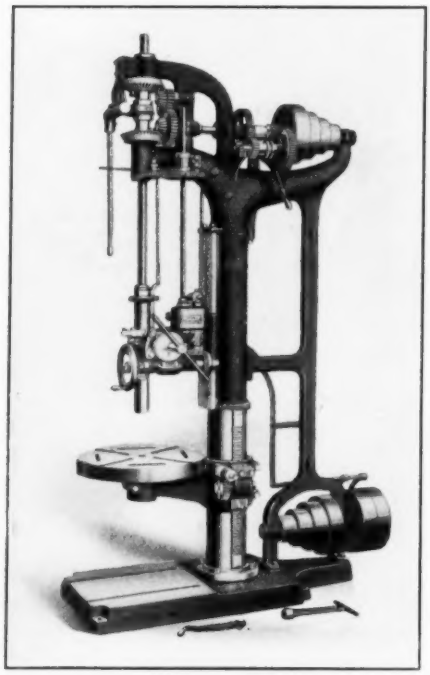


FIG. 1. UPRIGHT DRILL WITH POSITIVE GEARED FEED.

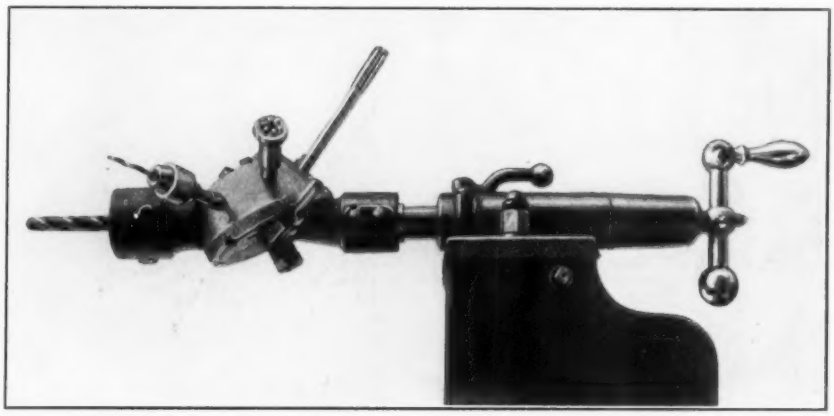
cones formerly placed on the top of the machine have been eliminated and the feed is now obtained thru gears entirely.

Mounted on the sliding head—and connected to the spindle by means of a train of gears and a splined shaft—is a quick-change feed box, clearly shown in Fig. 2. Thru this feed box six changes of feed are instantly obtainable by the movement of a graduated handle. These graduations indicate thousandths of an inch advance per turn of spindle, namely, 6, 9, 13, 18, 27 and 39.

The bevel gears and pinions shown at the top of the spindle are those forming part of the tapping attachment. The lever hanging down from the head—to the left of the spindle—is used to throw the clutch splined to the spindle between the two bevel wheels. By engaging with the lower bevel wheel the rotation of the spindle is in one direction; engaging with the upper reverses the spindle and drives it at a higher speed. This increase in speed is obtained by means of the spur pinion—mounted behind the upper bevel pinion—being driven by the spur gear secured to the upper cone shaft.

A TURRET HEAD.

The turret head shown in the half-tone is applicable to speed and engine lathes. It will be seen that the shank fits over the tail spindle of the lathe. The notches for indexing the head are on the outside, in view of the operator. This head is at present built in two sizes, the larger size for engine lathes up to 18 inches swing, having six holes in the turret. These holes may be as large as 1 inch diameter. The shank of this size is bored and reamed 1 15-16 inches diameter; it may be fitted to any tail spindle smaller than 1 15-16 inches by means of split bushings. The smaller size is intended for speed lathes. It has three ½-inch holes in the turret. These tools are made by the Baker Machine Corporation, New Bedford, Mass.



A TURRET HEAD.

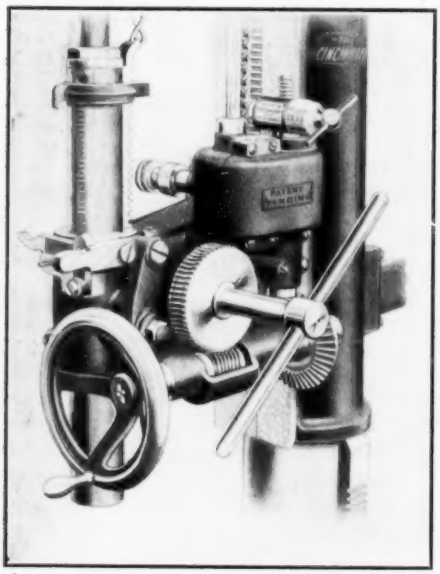
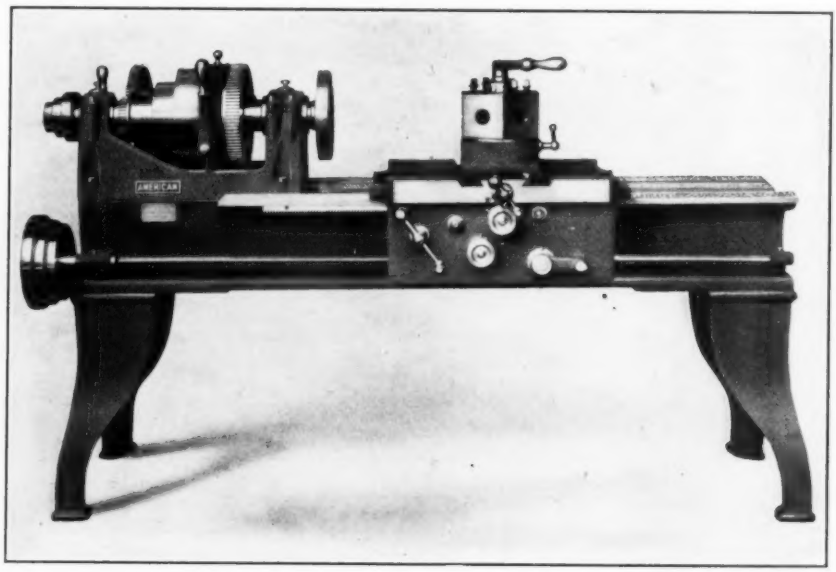


FIG. 2. THE FEED BOX.

MANUFACTURING TURRET LATHE.

The illustration shows a lathe designed and built especially for automobile and gas-engine manufacturers and others having a similar class of work. The headstock is bolted to the bed. The spindle of high carbon steel has a large hole thru it and runs in phosphor bronze bearings, having ample facilities for oiling and adjusting.



A MANUFACTURING TURRET LATHE.

It will be noted that there is no overhang to the hexagonal turret, the cross-slide being made wide with that end in view. A stop is furnished for centrally locating the turret for boring. Three

gradations of feed are provided both cross and longitudinal, obtained thru the belt-driven feed rod. Friction locking devices are used in the apron. The lathe is made in various sizes, with plain back geared, or friction geared headstock; belt or geared feed, with or without lead screw

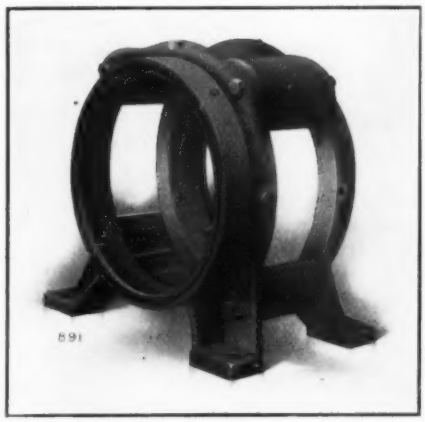


FIG. 1. MOTOR FRAME.

and the other attachments usually furnished with engine lathes.

The maker is The American Tool Works Company, Cincinnati, Ohio.

A NEW LINE OF ELECTRIC MOTORS.

The accompanying illustrations show the Lundell motor which is the product of the National Electric Company, of Milwaukee, Wis., and which is in several respects a new departure in motor construction.

The frame and magnet yoke are entirely distinct structurally, the frame being shown in Fig. 1. It consists of two rings with feet attached, the rings being identical except that the rear one has four horns projecting from it which are bored and fitted to the front ring, bolts passing thru both and clamping them solidly together. The magnet yoke is laminated and composed of ring punchings which are clamped between the two halves of the frame, their method of insertion being shown in Fig. 2, the entire magnet circuit being thus laminated. Moreover, structurally considered, the hight and width of the machine do not exceed the diameter of the yoke rings, as will be seen from Fig. 2. The pole pieces are separately punched from the same material as the rings. Their end plates are tapped, and retaining bolts pass thru the frame rings into the end plates and secure the pole pieces in position. By removing these bolts the pole pieces and field coils may be readily removed.

Another feature which is shown in Fig. 3 is the arrangement of the brushes. Instead of the brushes being placed on a stud side by side parallel with the commutator bars, they are here placed one directly in front of the other—that is, in tandem—each brush having its own independent spring. The result is that any irregularity of the commutator surface affects but one brush at a time and effective contact of one brush to each stud is therefore insured at all times, thus avoiding sparking and its consequent rise of temperature and injury to the commutator surface. When wide ranges of speed are intended thru field control, the brush at the leaving edge is made of high resistance carbon to take care of sparking conditions, while the other brush is of high conductivity to carry the current.

Fig. 4 shows the motor complete.

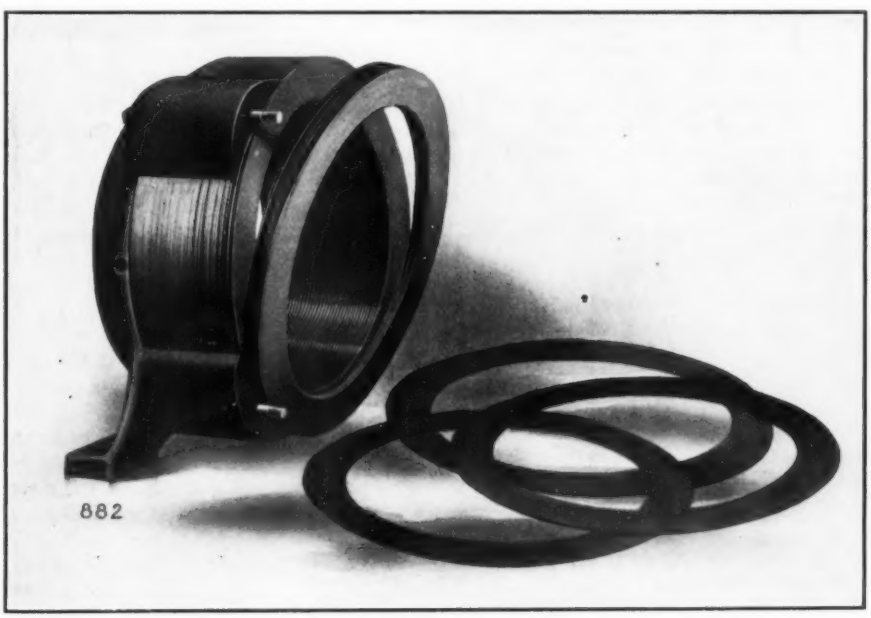


FIG. 2. MAGNET YOKE.

Monthly Meeting of the A. S. M. E.

The next monthly meeting of the American Society of Mechanical Engineers in New York, announced for Tuesday, February 28, will be held instead on Thursday evening, March 2. Mr. Worcester R. Warner will speak upon "Conditions in Panama and Reasons for a Sea-Level Canal." The lecture will be illustrated by views obtained by Mr. Warner upon his recent visit to Panama. These lectures begin at 8.15 P. M.

Oil Refining in Kansas.

We are sorry to see that the State of Kansas seems bent upon going into the business of oil refining. This is being done

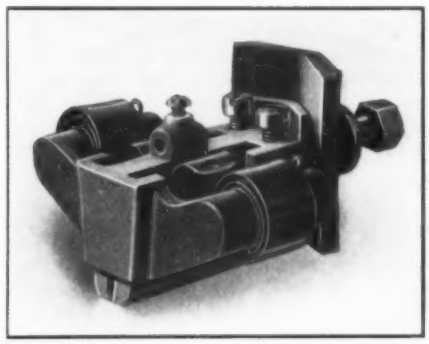


FIG. 3. BRUSH HOLDER.

in order to break the monopoly of the Standard Oil Company, and it seems to us that it is about the worst possible way of doing it. As we understand it, the Standard Oil Company maintains its monopoly in Kansas, not at all because it owns the only refinery there. We believe it is open to any citizen or association of citizens of Kansas to build another refinery in Kansas. If this is true, then there is no real monopoly of refining oil in the State. The trouble would commence when, the new refinery being completed, oil was wanted to be refined in it. Then it would be discovered just where the Standard's monopoly is and what it consists of. And having discovered this, the proper and right thing to do would be to take steps to break the monopoly and to so fix things that all who chose to operate refineries in the State could obtain oil upon the same terms; which of course means equal and even facilities for shipping or transporting oil over any portion of the State.

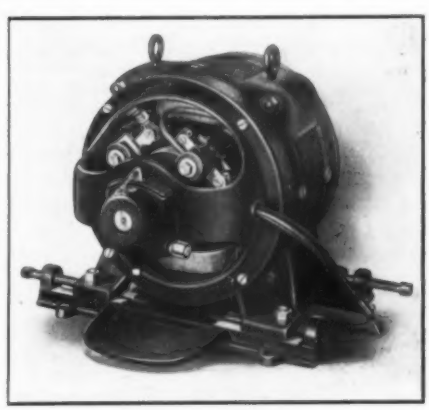


FIG. 4. MOTOR COMPLETE.

If a company were to monopolize the supply of leather and make arrangements for the practically exclusive shipment of

it over the territory of the State, the remedy would not be for the State to build its own shoe factories and leather belt factories, but to *destroy the monopoly*, and place all its citizens on an exactly even footing with regard to the right of transportation of supplies and finished goods. To build the shoe factories and the belting factories would be in accordance with the socialistic program, as is the building of the oil refinery to be operated by the State, but before doing this it would seem to be much wiser and much safer to try what actual commercial freedom would do—such freedom as would enable anyone whomsoever to go into the business upon exactly equal terms.

French Prize Emery Wheel Guard.

At page 1099, Vol. 26, was noted the opening of an international competition which had been started by the Association of Industrials of France against Accidents in Work, for the design of an emery wheel guard. Since then an award of the highest premium has been made to the house E. Thomé fils et M. Mairesse, of the Forge Nouzon, department of Ardennes, France, for a device submitted by it called

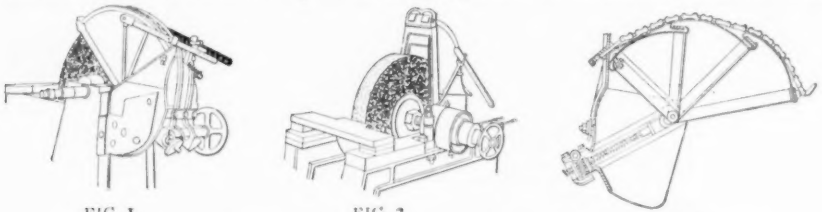


FIG. 1 FIG. 2 FIG. 3

FRENCH PRIZE EMERY WHEEL GUARD. *American Machinist*

the "Garant." A description of the same is obtained from an article by Jean de Vergnes in *La Métallurgie*.

The conditions imposed upon the competing designs were briefly as follows: A guard for a wheel mounted between two bearings, to prevent the flying of fragments, not to hinder working at any part of the wheel, not to decrease in utility as the wheel wears away, to be readily adaptable to the different types of stand, and to be moderate in price.

The "Garant" has shown that it can be mounted on a stand by one man in three hours. It has satisfactorily passed thru a shop service trial and a wheel-breaking test. The latter was made with a wheel 600x60 millimeters (24"x2⅜"). The speed was increased for 20 minutes, until the wheel broke into three pieces. The guard retained these so that they did not fly from the circumference of the wheel more than a few centimeters; the guard showed no deformation and seemed to the committee to work as well afterward as before.

Its construction is indicated by the accompanying cuts, Fig. 1 showing the guard in position for work, while in Fig. 2 it is folded back for changing the wheel or other purpose. The guard consists essentially of a steel hood in segments which fold back telescopically but in a manner not unsuggestive of a carriage top.

The hood, which is mounted on pivots independent of the bearings of the wheel, is formed of a series of safety arms, radiating in fan shape, holding between them spring plates and connected around the perifery with spring bands which cover the top. It is held in its different positions by a sprocket chain regulatable at the back with a hook mounted on a spring to deaden the first shock in case the wheel bursts. Further, a buff leather belt, in two parts suitably connected, covers the chain. Thus the spring bands, chain and belts reinforce each other.

Aside from its folding action the hood can be raised or lowered to allow changes in the size of the wheel. For this purpose the position of the pivots can be adjusted as shown in Fig. 3 by two screws controlled by worm gearing and a hand wheel.

These general arrangements apply to "Garants" for wheels of medium size, from 300 to 800 millimeters (12 to 31.5"). For larger wheels there are special features, notably the addition to the hood of two adjustable racks.

The inventors have also devised an arrangement to be placed under the wheel for the removal of the dust by suction, and a special type of emery-wheel stand.

The "Garant" has been patented in France and abroad. The prize offered for the invention was 1,000 francs, which could be split up if deemed advisable. We are not informed what proportion the "Garant" received.

Drawings, Dimensions Thereon, Etc.

BY A. D. WILLIAMS.

The test of a drawing is its freedom from all ambiguous expressions that demand explanation. It is commercially impractical in many cases to turn out such work, and for much shop work, it is probably safer to depend on certain shop conventions and rules. There is, however, no absolutely safe method that can take care of the personal equation present in each man.

A certain large firm having a number of plants scattered around the country, each provided with a drawing office, and in addition, a number of detached drawing offices are maintained at various centers. At the start it was found that the different firms taken over followed a variety of methods in their work, and it was impossible to transfer drawings from one works to another and work to them. The desirability of a uniform system was at once recognized and the matter was taken in hand in a thoro manner; each system was studied and compared with others and as far as possible, the best points of all were taken. The resulting book of standards contains nearly 100 pages, and has proven a great time saver. While this standardization was done with reference to a special line of work, some of the rules are of general adaptability and the following are quoted:

"Members shall be detailed in the position which they occupy in the structure, *i. e.*, horizontal members shall be shown lengthwise, vertical members crosswise on the sheet. Inclined members (and vertical ones when necessary on account of space) may be shown lengthwise on the sheet, but then always with their lower end to the left."

"Avoid notes as much as possible, where there is the least chance of ambiguity make another view."

"In detailing members which adjoin or connect to others in the structure, part of the latter shall be shown in red, sufficiently to indicate the clearance required or the nature of the connection. Plain building work is exempt from this rule."

The practise of this concern is to write all dimensions above one foot in feet and inches; below, in inches.

There are a number of methods used in indicating dimensions and the different kinds of fits and finishes necessary on the work. Where a firm is making a regular line of work, it would seem possible to settle on some standard of workmanship that would dispense with a great deal of the fancy abbreviations so common on drawings. If this was done a note would only be necessary when some departure from the standard was required.

It is also desirable that each piece should have some distinguishing mark which in addition to the drawing number should be marked on it. This would greatly facilitate the ordering of repair parts and spares, and save an endless amount of correspondence and trouble, to say nothing of time and worry. Different firms in many cases have different names for similar parts of machines, and a wired repair order has been delayed often owing to the fact that its recipient was poor at telepathic mind reading, and the sender had no mark to guide him, and hence named the piece. The experience of some firms in this regard has been such as to force them to make drawings of such pieces and get the parts made at home, even when considerable pattern work was involved. In some cases the purchasers insist on being furnished with sets of the detail drawings of machines.

New Publications.

The Macmillan Company, 64 Fifth avenue, New York, has issued a little handbook, price 25 cents, entitled "Notes for the Guidance of Authors in the Submis-

sion of Manuscripts to Publishers." It contains many things which it is convenient and comfortable for the writers of books and the contributors to periodicals to know. We would be glad if a copy of it was in the hand, and the substance of it in the head, of everyone who writes for us. Of course every detail of the book does not agree with our practise and recommendation, but it still is a good and handy book of its kind.

"Elements of Mechanical Drawing." Revised and enlarged edition. By Gardiner C. Anthony. 152 7½x5¾-inch pages, fully illustrated. D. C. Heath & Co., Boston. Price $1.50.

This book, which is one of a series, does not cover machine drawing at length, tho a few examples of machine parts are given. The subjects which are included are the solution of geometrical problems, drawing the conic sections, orthographic and isometric projection, the development and intersection of surfaces, spirals, helices, screw threads and bolt heads. The book is one of the most satisfactory of the many upon this over-written subject that we have seen, and is well adapted to private study, tho in this, as in other subjects, a teacher is highly desirable. The selection of problems is good, and there is no undue prolixity nor insistence upon trifles.

"Cyclopedia of Applied Electricity." Five volumes aggregating 2,500 8x10-inch pages, with 2,000 illustrations. The American School of Correspondence of the Armour Institute of Technology, Chicago.

This is an extremely ambitious and praiseworthy attempt to present the subject of electricity in all of its more important applications in a manner which is at once technical and at the same time within the capacity of the ordinary reader to understand. It is the joint work of more than a dozen writers and collaborators, some of whom are eminent in special branches of electrical work. The work will be found to meet the needs of the student, while many others will find it particularly good either as a reference book or as a source of information on branches of the suject which they may desire to inform themselves upon. There is surprisingly little mathematics and what there is is within the comprehension of those able to read simple algebra and trigonometry.

Obituary.

James Baldwin, foreman of the Knowlson & Kelly Corliss Engine Works, Troy, N. Y., died at Watervliet, N. Y., February 7, sixty-nine years old. He learned the machinist trade in England, but most of his active life was passed in this country.

Luiz Evaresto De Costa Cebral, of Rio de Janeiro, Brazil, a builder of machinery, chiefly for the coffee industry, died suddenly in a New York hotel February 16, sixty years old. He was considered one of the wealthiest men in South America.

William Braddon, of the editorial staff of *The Metal Worker, Plumber and Steam Fitter,* died suddenly, February 12, forty-eight years old. Mr. Braddon was born in England and was trained for the British Navy. He came to this country in 1892.

Charles J. Donnelly, son of John Donnelly, the pioneer manufacturer of lucifer matches, and himself the inventor of a match-making machine still in use, died in Philadelphia, February 16, fifty-eight years old. He had been ill thirty years as the result of phosphorus poisoning, of which his father also died. As usual with this disease, the lower jawbone was attacked and the entire bone had been removed.

Charles D. Edwards, the pioneer safe builder of Canada, died last month at Stoughton, Mass., sixty-three years old. He started the safe business in Montreal in 1857 under the firm name of Kershaw & Edwards, the members of the firm being sons of the heads of the firm of Kershaw & Edwards, of Boston, well known among early safe makers. Mr. Edwards had been at one time the financial support of eleven other concerns in Montreal.

Business Items.

The Meadville Vise Company, of Meadville, Pa., manufacturer of the Barrett horizontal boring mills and Meadville vises, has changed its name to Barrett Machine Tool Company; James O. Barrett, president.

The Bath Grinder Company, Fitchburg, Mass., states that the orders for its new universal grinder have been so brisk that it has been compelled to nearly double its capacity, and the new equipment will be installed in a few weeks.

H. H. Pease, for several years connected with the Nernst Lamp Company, has recently assumed charge of the Pittsburg territory for the C & C Electric Company and has offices in the Park Building, Pittsburg. Mr. Pease is well known by the electrical fraternity and enters this new field, making a specialty of complete isolated lighting plants and variable-speed motors for driving machine tools.

The Blanchard Machine Company, Boston, Mass., builder of special machinery and contract machine work, expects its new shop, which is being erected in Cambridge, to be finished in April. The company is now placing orders for the new equipment, and when it gets in its new quarters will have double the capacity of its old plant. The shop will be motor driven and have electric traveling crane.

The extensions to the Carnegie Institute Building, Pittsburg, Pa., are rapidly nearing completion. They represent an expenditure of $5,000,000, the munificent gift of Andrew Carnegie. The contract for the electric generators has been let to the National Electric Company, Milwaukee. It consists of five 300-kilowatt, 120 R. P. M., 12-pole, 125-volt, direct-current, engine-type generators. These machines will be of the latest design and best material, of massive tho pleasing appearance, the heaviness in outline being relieved by the elliptical section of the frame. All visible bolts will be nickel plated, and the field coils taped on the outside and finished with a wrapping of fish net cord. The terminal boards will be of Vermont marble. The total net weight of each generator will be about 55,000 pounds, the armature and commutator accounting for 18,000 pounds. On the final test the generators will be expected to withstand a momentary overload of 75 per cent. without flashing, and to operate from no load to 25 per cent. over load without shifting the brushes.

The Westinghouse Electric & Manufacturing Company has closed a contract for electrical equipment for another large cotton mill, that of the Dwight Manufacturing Company, of Chicopee, Mass. The contract provides for the following apparatus to be delivered and erected by the Westinghouse Company: One 440-volt A. C. generator, 900 kilowatts rated capacity, to supply three-phase current at a frequency of 60 cycles (this generator is to be direct connected to a C. & G. Cooper 26 and 52x48-stroke cross-compounding condensing); one 25-kilowatt exciter direct connected to Westinghouse engine, and one 22½-kilowatt, motor-driven exciter. There will also be provided a four-panel switchboard to control generator, exciters and six feeders. The electric power plant is to be placed in a new building to be built as an addition to one of the present engine-houses; in this way putting the two engines under the supervision of one engineer. To utilize the current produced by this plant, the following Westinghouse type "C" motors, wound for 60 cycles, three-phase, will be located in the various parts of the mill: Two 200 horse-power, 580 R. P. M.; six 100 horse-power, 580 R. P. M.; three 75 horse-power, 690 R. P. M.; three 50 horse-power, 850 R. P. M.; two 40 horse-power, 850 R. P. M. The complete equipment of the new plant is from the plans of Messrs. Lockwood, Greene & Co., of Boston.

Manufacturers.

The Sumter (S. C.) Iron Works will enlarge its plant.

The Ball Engine Company, Erie, Pa., is extending its plant.

J. F. Pyle & Sons, San Jose, Cal., are putting up a new cannery.

The National Clock Company will erect a factory in Oxford, Ohio.

The Union Pacific is planning to double its plant at Laramie, Wyo.

Deeds & Hirsig will erect a large wagon factory in Nashville, Tenn.

The Pender Nail Works Company, St. John, N. B., will extend its plant.

The Davenport (Ia.) Locomotive Company is building a new boiler shop.

J. C. Lautenbacher, Schuylkill Haven, Pa., will erect a new knitting mill.

The Hershberger-McAfee Woolen Mill Company will erect a four-set mill.

The Capital City Canning Company, Esquimalt, B. C., is erecting a plant.

The Fall River (Mass.) Iron Works will, it is reported, build another mill.

The Appleton Mill Corporation, Lowell, Mass., will erect a new cotton mill.

The Storm Lake (Ia.) Cannery Company will erect a factory, to cost $25,000.

The East Side Planing Mill, Des Moines, Ia., will build an addition to its plant.

W. C. Metts, of Paradise Valley, Ind., will erect a canning factory in Tulsa, I. T.

Hubbard & Eldridge, Rochester, N. Y., chair manufacturers, will erect a new factory.

The Merchant Iron Mill at Rome, N. Y., has been destroyed by fire; loss, $200,000.

The United Railways & Electric Company, Baltimore, Md., will erect new power-house.

The Pope Gosser China Company, Coshocton, O., will double the capacity of its plant.

D. B. Smith & Sons are building an addition to their cotton mill at Pine Meadow, Conn.

The Nashua (N. H.) Manufacturing Company, cotton mills, will erect a new dye-house.

The Fibrous Cork Insole Company, of Lockport, N. Y., will erect a $60,000 plant in New Castle, Pa.

The Eureka Knitting Mill Company, Schuylkill Haven, Pa., has been formed and will erect a mill.

The American Fiber Matting Company, Patchogue, L. I., has been organized and will install a plant.

The Schmoller & Mueller Piano Company, Omaha, Neb., will enlarge its plant, installing new machinery.

The Toronto (Ont.) Roller Bearing Company will probably establish a branch factory in Winnipeg, Man.

The Hughes Manufacturing Company, Los Angeles, Cal., planing mill, sashes, etc., will enlarge its factory.

The Blanchard Machine Company, Boston, Mass., has let the contract for a machine shop in Cambridge.

The Watkins Foundry & Machine Company, Hattiesburg, Miss., whose plant was recently burned, will rebuild.

Wheelright Bros., Ogden, Utah, will shortly erect a factory for the manufacture of cement building blocks.

The World's Star Knitting Company, Bay City, Mich., will build an addition to its plant, including a power-house.

The Glen Riddle (Pa.) Manufacturing Company will double the capacity of its mill for manufacturing cotton wadding.

It is reported that Vienna, Ga., will have a new $100,000 cotton factory. P. G. McDonald, of that place, is interested.

The Akron-Selle Company, Akron, O., manufacturer of wagon gears and governors, will make an extensive addition to its plant.

Lawrenceburg, Ky., will soon have an electric light plant. The Commercial Club of that place is conversant with the details.

The Lombard Governor Company has bought a plant in Ashland, Mass., where it will manufacture high-grade water-wheel governors.

The Walker & Pratt Manufacturing Company, Watertown, Mass., will enlarge its molding, core, pattern and machine shops.

The Kinnear Manufacturing Company, Columbus, O., will erect a new plant. The company manufactures steel doors and shutters.

Andrew Fyrberg, who recently sold his firearms plant to Sears, Roebuck & Co., will establish another factory in Hopkinton, Mass.

The Wm. E. Pratt Manufacturing Company, Joliet, Ill., will enlarge its plant. This company manufactures malleable steel castings of all kinds.

H. L. Maxfield, Norman Carle and others at Janesville, Wis., are organizing a company to build a $20,000 foundry for gray iron machine castings.

The American Conduit Company, recently organized, headquarters of which will be Toledo, O., will, it is said, erect a factory in Auburndale, O.

The New Irene Mills Company, of Gaffney, S. C., has secured a building and will at once equip it with machinery for manufacturing damask tablecloths.

The Star Electric Company, Binghamton, N. Y., has reorganized, increasing its capital stock and will erect other buildings, installing new machinery.

The Ball Bearing Hat Stand Company, Waterloo, Iowa, has been organized with a capital stock of $25,000; A. J. Falls, Hudson, Iowa, president.

The Lloyd Manufacturing Company, Minneapolis, Minn., maker of wire goods and automatic wire machines, is contemplating the erection of another factory.

The Sandusky (Ohio) Stove Company, recently incorporated, will probably locate its factory in Fremont. Thos. H. Conway, of the Lincoln Range Company, of the latter place, is interested in the new concern.

The Leffingwell-Abbott Construction Company, Ocala, Fla., will commence erecting a 3,000-light electric light plant at Tarpon Springs, Fla., within sixty days., and is open for quotations on all types of machinery, both steam and electrical.

The New York Central Railroad Company has completed plans for the erection of a tank and boiler shop at West Albany, N. Y. The building will contain the most modern machine equipment, such as overhead cranes, "chippers," rivet drivers, etc. A good proportion of these machines will be driven by air pressure, and there will also be a quantity of portable air machines of smaller size.

New Catalogs.

W. N. Durant Company, Milwaukee, Wis. Catalog of counting machines, for use in machine shops, metal stamping works, etc. Illustrated. 6x9, pp. 20, paper.

Manzel Bros., 46-48 Broadway, Buffalo, N. Y. Pamphlet telling how to secure positive lubrication by the use of Manzel pumps. Illustrated. 3½x5, pp. 20, paper.

Clayton Air Compressor Works, 114 Liberty street, New York. Bulletin C201. This describes improved type of Clayton air compressors. Illustrated. 6x9, pp. 48, paper.

Lyon Metallic Manufacturing Company, Chicago, Ill. Catalog describing steel furniture and equipment for factories, foundries, shops, etc. Illustrated. 6x9, pp. 48, paper.

Shultz Belting Company, 113 Liberty street, New York. Pamphlet describing Shultz Sable rawhide belting. Contains some rules and problems for finding length and width of belt. Illustrated. 3½x6, pp. 12, paper.

Fiseher Foundry & Machine Company, Pittsburg, Pa. Catalog containing very fine half-tone illustrations of various machines made by this company for rolling mills, steel works, tube mills, boiler shops and bridge works. 8x 10½, pp. 171, paper.

H. W. Johns-Manville Company, 100 William street, New York. Pamphlet entitled "Pipe and Boiler Coverings and Their Uses," describing various forms of asbestos and 85 per cent. magnesia sectional pipe covering. Illustrated. 3½x6, pp. 12, paper.

International Acheson Graphite Company, Niagara Falls, N. Y. Booklet, "Protection, Resistance, Durability," describing the methods of manufacture in the electric furnace and use of Acheson graphite for paint pigment. Illustrated. 4½x7½, pp. 23, paper.

C. W. Hunt Company, West New Brighton, N. Y. Pamphlet No. 051. Hunt Industrial Railways. Illustrated. 3½x6, pp. 29, paper. Pamphlet No. 052, which is an introduction to the general line of machinery manufactured by this company. Illustrated. 3½x6, pp. 20, paper.

Miscellaneous Wants.

Advertisements will be inserted under this head at 25 cents a line each insertion. Copy should be sent to reach us not later than Saturday morning for the ensuing week's issue. Answers addressed to our care will be forwarded.

Caliper cat. free. E. G. Smith, Columbia, Pa.

Punches & dies. Wal.M.Wks.,Waltham,Mass.

Light mach'y to order; model work; rubber molds. J. M. Weir, Bridgeport, Conn.

Any manufacturer desiring to build gas engines address Box 324, AMER. MACHINIST.

Will buy or pay royalty for good patented machine or tool. Box 282 AMER. MACHINIST.

Light and fine mach'y to order; models and elec. work specialty. E. O. Chase, Newark, N. J.

A set of steel figures, size 3-32 or ⅛ in.; $1.25, post paid. J. L. Lucas, Bridgeport, Ct.

Salesman of machinery supplies to handle "Lang's T-bolt heads" on commission. G. R. Lang Co., Cincinnati, O.

Automatic machinery designed and constructed by the Wellman Sole Cutting Machine Co., Medford, Mass.

The Canada Machinery Company, Limited, Sarnia, Canada, have the facilities and are open to manufacture, for patentees and others, machines and machinery for the Canadian market.

Modern foundry and machine shop, fully equipped for light and medium heavy work, wishes to manufacture engines, machines or machine parts; would undertake sale if desired; castings made in malleable, gray, brass, bronze and aluminum. Trenton Malleable Iron Co., Trenton, N. J., and 26 Cortlandt st., New York.

Wanted—To furnish competent men for positions as managers and heads of departments in the metal-working or machine business and the past experience of each, for which there is no charge; also want competent men to register for such positions. Address James Brady, 168 Lefferts Place, Brooklyn, N. Y.

Machine Shop and Foundry.—We offer a complete machine shop and foundry, fully equipped with modern machinery; has five lathes, four planers, including 48 in. x 48 in. x 10 ft. Pond, three drills, shaper, milling machine, gear cutter, keyseater, 30 H.-P. gas engine, lighting dynamo and many other machines. Patterns for a complete and profitable line of standard machines. Plenty of jobbing work. The foundry has complete equipment. Located in a good Ohio city. Price less than one-half original cost, and will be sold on easy terms. Business is improving rapidly. By spring all the shops will be full of work. Now is the time to start in business. Wm. A. Reade & Co., 402 Chamber of Commerce Bldg., Cleveland, Ohio.

For Sale.

For Sale—Long-established machine shop in this thriving city; cause of sale, death in firm. W. D. Judson, New Haven, Conn.

I can sell your machine shop (or other business), with or without real estate, no matter where it is or what it is worth. Send description, state price and learn how. W. M. Ostrander, 111 North American Bldg., Philadelphia.

Factory property for sale or rent at Plainfield, N. J.; building, 24 by 60; 15 H.-P. Fairbank-Morse gasoline engine, shaft and belt; lot 200 by 200, with railroad siding; immediate possession. Apply A. J. Brunson, Plainfield, N. J.

For Sale—United States patent No. 719,854, 1903, for best water gage in the world; now giving splendid results on English market; see description on page 788, December issue of POWER. Apply James Robinson, G. P. O., Leeds, England.

For Sale—A modern machine shop, complete with water power, suitable for manufacturing and jobbing purposes; is now running at Londonderry, Vt.; cause of selling, death of proprietor. Address Mrs. H. A. Hayward, Londonderry, Vt.; or Kansas City Machine Works, Kansas City, Mo.

Wants.

Situation and Help Advertisements only inserted under this head. Rate 25 cents a line for each insertion. About six words make a line. No advertisements under two lines accepted, and no advertisements abbreviated. The cash and copy should be sent to reach us not later than Saturday morning for the ensuing week's issue. Answers addressed to our care will be forwarded. Applicants may specify names to which their replies are not to be forwarded; but replies will not be returned. If not forwarded they will be destroyed without notice. Original letters of recommendation or other papers of value should not be enclosed to unknown correspondents. Only bona-fide situation want or help want advertisements inserted under this heading. Agency advertisements must be placed under Miscellaneous Wants.

Situations Wanted.

Classification indicates present address of advertiser, nothing else.

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Draftsman (mechanical, electrical) or tracer; young; bright. Address Box 313, AM. M.

Broadly qualified machine works general